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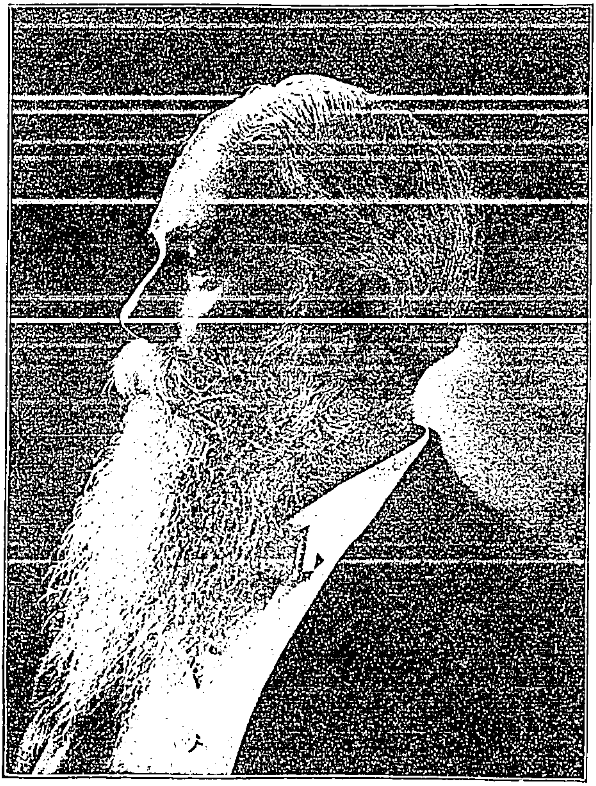

HON. SANFORD B. DOLE.
President of Hawaiian Sugar Planters' Association.
1885-6.

NEW YORK, Jan. 23.—Raws advanced ⅛c. Refined advanced 10 points. Net cash quotations are: Centrifugals, 3.50c.; Granulated, 4.51c. Total stock in Four Ports, 116,207 tons. Estimated afloats to the United States from Cuba and West Indies, 10,000 tons; Javas, 15,000 tons; Hawaii, 10,000 tons; Europe, 5,000 tons; Peru, Demerara, &c., 35,000 tons; total 75,000 tons, against 11,000 tons last year.

A firmer feeling has developed this week, due to the withholding of Cuban sugars and the lack of available supplies of other cane sugars to meet requirements for the immediate future. Receipts have been less than the meltings, with no large supply on the way, and refiners' stocks, while ample for present needs, are not excessive. Sugars arriving, therefore, meet with ready sale.

During the week under review, centrifugals on the spot have been sold at 3⅜c, for 96° test. We think this marks the limit of the decline and base this upon the fact that, as Europe holds the bulk of surplus supplies, and has at no time declined below 6s. 4½d., the parity of 3 9-16c for centrifugals, and is today 2¼d. above the lowest point, thus giving a strong indication that the worst has been seen. European markets show a net advance of ¾d., and are now about ⅛c. above the parity of Centrifugals.

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HAWAIIAN SUGAR CANE.—We have been asked several times, what is the largest quantity of sugar cane grown on one acre, but have never before been able to state, even approximately. The following clipping from the Hilo Herald is reliable as regards cane grown on the new plantation at Olaa, Hawaii—a yield of 186,000 pounds. It would be interesting to know how many pounds of sugar were obtained from it, and we hope to be informed:

"On a knoll back of the residence of J. F. Clay, an acre of cane was surveyed by S. G. Walker and cut in order that the tonnage might be learned. It was placed on the scales and showed ninety-three tons, which is enormous, considering the fact that the location was such that heavy rains would have a tendency to wash away the fine top soil. The average yield of Olaa will probably reach forty tons to the acre."

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Bicycles are taxed in France, and there are about one million licensed. The tax is light—a little over one dollar a year. All bicycles there have to be licensed or registered. The public roads there are kept in good condition for these and other vehicles.

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The cultivation of beets in France is to be restricted by a tax or license. This and the low price of sugar in Europe will largely curtail the annual yield. Beet culture has been largely assisted in Europe by government bounties, which, though small, have helped to create a large surplus of sugar there.

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The agreement known as the "Kartell" which has subsisted between the Austro-Hungarian raw sugar manufacturers and refiners since 1897, was originally made for five years, and will consequently come to an end in 1902, unless in the meantime, arrangements are made for its renewal. As in the case of the German "Kartell" which was practically formed on the basis of the Austrian one, it is an agreement to keep up the prices in the inland market, and to divide the profits between the two branches of the sugar industry, the raw sugar manufacturers being guaranteed a minimum price for their production.—Int. Sugar Jour.

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The New York Independent says: "We rejoice that there is a fair reason to hope that the law excluding the Chinese from entering the United States will not be re-enacted. The law is quite ineffective, altho much money has been spent in enforcing it. Those Chinese that want to get in find their way over Canadian or Mexican frontier. Besides, the law is an affront to China, and so long as the Japanese are admitted there is no reason why the Chinese should not be also. We need just now to be courteous to China if we would develop our commerce in Chinese ports. Chinese are constantly entering the United States via Vancouver or Mexico, and no patrol force can prevent them.

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## *CUBAN SUGAR.*

Recently a number of merchants arrived at New York from Cuba to urge Congress to remove the duty on sugar imported from Cuba. On the same day, one of the Havemeyer firm predicted that "inside of a year raw sugar would be placed on the free list, and refined sugar be selling as low as three cents per pound." When one remembers how much influence the sugar trust has had on Congress in past years, it is reasonable to suppose that they can bring a large number of congressmen and senators to see the free sugar proposition from their point of view. Possibly, the Cuban merchants will not be as anxious for free raw sugar as for free Cuban raw sugar. Since 1896 the United States has averaged to import $16,105,206 worth of beet sugar not above No. 16 Dutch standard. In the same time we imported $69,729,434 worth of cane sugar not above No. 16, while the average importation of all sugars above No. 16 Dutch standard for the last five years amounted to an average of only $2,960,119. This brings the annual average of the total imports of sugar to the United States in the last five years up to $88,794,759.

Of this amount 18.15 per cent. came from Cuba, 17.95 from the Dutch East Indies, 17.76 from Hawaii and 16.29 from Germany. From these figures it will be seen that these four places supplied more than 70 per cent. of the total value of sugar imports of the United States in the last five years. But it should be remembered that this five years takes in the war period in Cuba. In 1896 ou imports of sugar from Cuba amounted to $24,102,835. In 1897 they dropped more than one-half to $11,953,987. In 1898 there was a still further decline to $9,828,607. Since then there has been a rapid advance, and in 1900 the imports of sugar from that fertile island amounted to $18,243,635. In 1896 the imports from Cuba exceeded those from Hawaii and the Dutch East Indies combined, while in no year since 1896 have the sugar imports from Cuba been as great as those from either Hawaii or the Dutch East Indies. As we have said before, if Cuban sugar was allowed to enter free of duty, the production of that island would advance to figures almost double what they were last year, and with Hawaii, Porto Rico and Louisiana all producing cane sugar, there will be very little likelihood of our needing to import any from other countries, for which a duty would have to be paid.—Boston Globe.

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## *IMPROVEMENT OF THE SUGAR CANE.*

Our readers are aware, from previous references made in the Monthly, that Dr. Morris, the British Commissioner of Agriculture for the West Indies, has for several years been, through his able assistants, Messrs. Albuquerque and Bovell, engaged in efforts to improve the sugar cane. This is done chiefly by seedlings or new plants raised from seeds. It is hardly a dozen years since the discovery was made that sugar canes produced seeds. They were always propagated by cuttings. Now new varieties are obtained by planting seeds. In this way a large number of entirely new canes have been obtained. In a recent publication he states that there is now reasonable hope of being able to increase the sugar contents of cane, and eventually of placing within reach of the planter canes that will not only yield forty to fifty per cent more sugar than at present, but will also, if placed under suitable conditions, withstand to a considerable extent the attacks of disease. A large number of sugar canes have been raised from seed in the British West Indies, and it is stated that the famous seedling B. 174, has given in Barbados results 40 per cent to 50 per cent better than white transparent; while D. 145, a Demerara seedling, was thirty per cent more productive than Bourbon. Should these varieties continue to give such excellent results over a period of years, they will prove a most valuable acquisition to sugar planters.

Another of the Doctor's new canes is named B. 147—a delicate slow-growing cane when young, and one which does not appear to germinate freely when planted late in the season; from 11 to 12 canes to the clump. Of a bright yellow color, with long cylindrical internodes of about 4 to 8 inches long having a slight longitudinal channel on the side the bud is attached; very rarely arrows. There is a tendency for the sheaths of the fallen leaves to remain attached to the lower half of the cane until towards the close of the year, and for this reason the sleeping roots of the nodes begin to start into life; these, however, dry on being exposed, as the leaves fall. It is on the whole a hardy, vigorous, upright grower with considerable power for resisting periods of drought. A late ripener.

Quite a large number of new canes have been tested, only the most promising of which are kept. The "Barbadoes seedling 208," he says, was the best all round cane, taking into account its ready germination, the general absence of disease, the yield of sugar, the great richness and purity of its juice and the satisfactory results obtained in both black and red soils, plants and ratoons. It maintained its position notwithstanding the trying weather conditions. The indicated muscovado sugar yield was 2.6 tons per acre, as an average for all the stations under experiment, for both plants and ratoons. The juice was highly suitable for the muscovado factory, and was so rich and pure that the cane could safely be mixed with others not so rich and pure in order to enable the planter to make a better class of sugar.

These extracts will indicate the work in this line that is being done abroad. Regarding his work he says: We also hope to extend the experimental cultivation of the best three or four varieties, together with the White Transparent as a standard, to a small estate scale of one acre plots planted in duplicate. By weighing the canes, crushing them in the estate mill and analysing the juice, we shall obtain results that will form a valuable complement to those obtained by our present methods.

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A hard frost occurred in Louisiana about the middle of January, and the Planter refers to it in the following note: "A general loss from the freeze is chronicled everywhere, varying in extent according to the amount of cane which it caught standing and in windrow, the standing cane being, of course, the most seriously injured. Very few factories were fortunate enough to finish before the injury to their raw material became manifest. The cool weather we have had for the past few days has been of good effect in retarding the progress of deterioration in the canes yet to be ground."

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The silk industry has grown very rapidly in the United States during the past few years, and there are now 750 silk factories in nineteen States. As the silk worm does not thrive in the States, all the silk thread is imported from other countries, the annual importations during the last few years having exceeded $40,000,000, the average price being $4.20 per pound. All the silk fabrics made are consumed at home, none being exported.

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## *SUGAR IN POLITICS.*

Very strong efforts are being made on the part of the administration and some of the leading members of Congress, combined with the refinery interest, to secure the admission of the Cuban sugar crop at a reduced and nominal duty, giving it practically a free entry. These efforts will probably result in the adoption of a reciprocity treaty admitting raw Cuban sugar under a nominal duty, in consideration of free entry of American merchandise into that island. Fear is entertained that under this treaty free trade between the two countries will be practically established, and as a result Cuba will find an almost free outlet for her large sugar crop, which before the war amounted to one million tons, and which may easily be augmented to two or three millions annually. The effect of such legislation will surely be to check the rising domestic beet sugar industry and possibly the cane sugar manufacture in the United States. Very powerful influences, including the combined sugar refineries, are being brought to secure this measure, but with what success remains to be seen. The fact that the powerful Sugar Refinery interest is working hard for it, indicates that it may possibly be enacted as a law.

The question of the future position of Cuba towards the United States, says the Manchester Sugar Journal, is one of very considerable interest to the entire sugar world. The rate of progress in development of the Cuban sugar production is largely dependent on the encouragement afforded to or withheld from the industry by the more or less advantageous fiscal relations with the United States. The present purveyors of a large portion of the sugar requirements of the latter country are therefore very largely interested in the matter. Among these the most seriously concerned are Java, Egypt, Germany, Austria-Hungary, and the whole of the West Indies and Demerara. But the most seriously affected country is, after all, the United States, as regards the beet industry, which is now commencing to make rapid progress. No wonder that the views as regards Cuba, which have lately been put forth by American refiners and the tactics which they are pursuing should excite great alarm in American beet-growing circles. The proposal to abolish the import duty on raw sugar while maintaining a duty of one-half cent per pound on refined, combined with the issue by the American Sugar Refining Company of $15,000,000 new stock for operating in Cuba and Porto Rico, producing raw sugar in those countries by cheap labor—Porto Rico sugar being now free, while it is not impossible that Cuban sugar may soon enjoy the same privilege—is calculated to excite grave apprehension among the beet sugar manufacturers. Under the present protective duty they are enabled by good management and with favorable conditions of weather to make good and even large profits, but if the favoring protective duty were abolished there is no doubt the rapid increase of cheaper produced Cuban and other cane sugar would rapidly extinguish the nascent industry. Louisiana and Hawaiian planters are concerned in this matter.

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## *AMERICA AS A COFFEE CONSUMING COUNTRY.*

Commercial statistics of the past year show that the coffee importations of the United States in 1901 were the largest in the history of the import trade. Figures of the Treasury Bureau of Statistics show that importations amounted to 967,969.585 pounds in the eleven months ended with November, against 707,466,152 in the corresponding months of 1900, and 817,223,877 in the corresponding months of 1899.

"These figures indicate not only that the coffee importations will be larger than those of any preceding year, but they will for the first time exceed one billion pounds, says a Washington dispatch. The value of the coffee imports of the year will be about $70,000,000.

"Brazil, of course, furnishes the largest proportion of the coffee importations of the United States. In the eleven months ended with November the coffee imports from Brazil amounted, according to the Treasury Bureau of Statistics, to 762,148,514 pounds, while the next largest quantity came from other South American countries, 91,297,714 pounds; Central America, 64,554,400; Mexico, 21,594,432. Thus of this largest single importation in the entire list of imports, sugar excepted, nearly all comes from American countries south of the United States, and this is equally true of sugar, excepting that which is drawn from the Hawaiian Islands.

"The United States is by far the largest coffee consuming country of the world, as will be seen by the following table, which shows the importation of coffee into the principal countries of Europe and into the United States in 1899:

| Countries into which imported. | Total consumption pounds. | Per capita. consumption pounds. |
|---|---|---|
| Russia | 18,396,000 | — |
| United Kingdom | 29,120,000 | .72 |
| Italy | 31,222,000 | .98 |
| Austria-Hungary | 92,180,000 | 2.04 |
| France | 179,120,000 | 4.62 |
| German Empire | 343,501,000 | 6.12 |
| United States | 801,857,000 | 10.79 |

—Tea, Coffee and Sugar.

## *COST OF REFINING SUGAR.*

The statement by Messrs. Oxnard and Cutting as to the cost of making beet sugar, recently printed in the New York Evening Post, not only demonstrated that the domestic beet sugar industry would continue a very profitable industry under free raw sugar, but it also proves that free raw sugar, with a duty of one-half cent on refined, places the refining industry using foreign raw sugar at a disadvantage as compared with the domestic beet sugar industry. Raw sugar is now at the lowest cost in bond ever known, or for 96 test centrifugals, 2 cents per pound. There is needed to make granulated, to cover cost and waste and leave a reasonable profit for the refiners, 1 cent per pound, equivalent to a cost for granulated made from free foreign raw, of 3 cents per pound.

Messrs. Oxnard and Cutting admit the manufacture of granulated from beet sugar at a cost of 2½ cents per pound. With a duty on refined of half a cent a pound they have a margin against foreign made beets of half a cent per pound.

So that with granulated at 3 cents there is a good profit; but they also have a difference in their favor of the freight to the West of one-quarter to one-half cent per pound, making a protection of from three-quarters to 1 cent a pound under absolute free raw sugar.

Messrs. Oxnard and Cutting, however, intimate that at their best factory they believed the cost of manufacture would be reduced to $2.00 per ton, which, added to $4.00 per ton cost of beets, would make $6.00 per ton of beets, yielding 260 pounds of granulated at a cost of 2.31 cents per pound, thus making a profit of 69 cents per hundred with granulated at 3 cents, or 30 per cent profit.

The above statement is fully corroborated and confirmed by Messrs. Oxnard and Cutting's statement as follows:

"There is a seven years' contract in our new factory at Hueneme paying $4.00 as an average price for beets. If we add to this the cost of manufacturing these beets into sugar, we will find that $3.00 will cover every expense. Our figures, based upon averages in our factories located in California and Nebraska, show that $2.50 per ton covers the actual expenses of manufacturing sugar, and in the new factory, which is three times as large as the Chino factory, we expect to reduce the cost below $2.00; but, for the sake of conservatism, we will place the figures at $3.00: Beets, $4.00 per ton; expense of working beets into sugar, $3.00 per ton; total, $7.00 per ton; amount realized from the sale of the product at 4 cents per pound, $10.00; net profit per ton, $3.00.

"The factories are capable of manufacturing at least 350,000 tons of beets into sugar per annum; 350,000 multiplied by $3.00 would give $1,050,000 (this at 4 cents per pound; at 3 cents per pound, 25 per cent less, $780,000) as the income to be derived under absolute free trade, should the price of sugar be at the lowest price prevailing during the years when all duty was removed from raw sugar."

With this statement the protest of the beet sugar men that free raw sugar would ruin their industry is false and preposterous. It is in marked contrast to the policy of the refiners of foreign raw sugar, who favor the removal of the duty in order that the business may be extended and the consumption increased 25 to 30 per cent; old industries using sugar enlarged; new industries created; exports of preserves, jams, jellies, and canned fruits increased, and benefits large and generous given to every consumer in the United States.—Am. Grocer.

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"The total population of the United States at the close of the nineteenth century was about 84,250,000. As the population, at the beginning of the century, was about 5,333,000, the Nation has grown nearly sixteen fold in one hundred years." The largest, most compact, and the most closely knit Caucacian population of the world today is that of America, and today she is potentially the most powerful of all the world-powers. Why? Because her unit of population is superior.

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War Between Cane and Beet.—What is thought to be the opening of war between the cane-sugar trust and beet-sugar interests, has recently developed. Nearly $100,000 worth of cane sugar, in excess of the amount required to supply the local demand, has been shipped to Lacrosse, Wis., to the representative of the cane-sugar trust. Similar shipments have been made to Minneapolis, St. Paul and other Northwestern distributing points. The trust, it is believed, intends to flood the market and compel small independent beet-sugar interests to close.—Ex.

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Remittances of Japanese Laborers.—The Japan Chugai learns on reliable authority that the average yearly sum of money remitted home by the Japanese laborers in Hawaii during the past ten years was between 2,500,000 yen and 4,000,000 yen. Besides these laborers, who number about 60,000 at present, there are another 60,000 in Korea and Ceeanea, and supposing those in the latter places are equally thrifty and equally mindful of remitting their savings from time to time as their brethren in Hawaii, Japan, it may be said, is actually receiving as much as 8,000,000 yen of foreign funds every year. If this is the case our laborers in foreign lands appear to each save about 66 yen per year.—Japan Times.

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Throw a bone to a dog, said a shrewd observer, and he will run off with it in his mouth, but with no vibration in his tail.

**Call the dog to you, pat him on the head, let him take the bone from your hand, and his tail will wag with gratitude. The dog recognizes the good deed and the gracious manner of doing it. Those who throw their good deeds should not expect them to be caught with a thankful smile.**

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## *SUGAR AND THE CUBAN POLICY.*

A grave question is now being agitated regarding Cuba or rather regarding the policy of admitting her sugar into the United States free of duty. It is a question in which every cane and beet grower in the United States and its dependencies is interested, and should be thoroughly discussed before it is finally acted on. In a lengthy article, the New York Times in common with many leading papers in the States, takes strong grounds against it. It says:

"We have spent sums estimated at from $350,000,000 to $700,000,000 on the political freedom of the Cubans. That is not enough, it seems. We must spend more for their industrial maintenance. This is, we say, the only argument. Secretary Root's contention that we owe something to the fact that "Cuba has acquiesced in our right to say that she shall not put herself in the hands of any power, whatever her necessities," is beneath the dignity of so eminent a lawyer. Cuba can make a reciprocity treaty with any power in Europe tomorrow, and Mr. Root knows it. If the Cuban sugar planters are a charge on the incomes of the Americans, they are on the incomes of all Americans. They are not on the growers of the 150,000 tons of domestic beet, of the 350,000 of Louisiana and 150,000 of Hawaiian cane, whom openly and avowedly they propose to supersede in American markets. That which they ask is the remission of a duty of $48,981,060 on their products. Presumably, then, they need that amount "in their business." We do not say that they should not get it. But, we say, take it directly out of the treasury, which is filled by contributions in taxes of the whole people. Vote the Cubans the $50,000,000 a year they want, but do not vote it out of the pockets of the few million Americans whom their unrestricted competition admittedly would ruin, generous at its own expense, but anything more contemptible than the generosity of a great nation at the expense of a comparatively limited number of its own citizens, to whom it has broken a solemn pledge of adequate protection in their calling, is unimaginable. Buy the bankrupt planter's lands if need be; give them United States bonds for their holdings and put some one on the soil who will not seek to contravene commercial civilization with his crop, some one who will raise those products of the tropics which are not a competition with the products of the temperate zone. The future of Cuba—sooner or later to arrive, in common with that of the possessions—the production of the coffee consumed in the United States and now imported in the main from Brazil.

"This is the right of it, on which the might of it is infrequently based. The sugar growing industry of the United States is not to be overthrown for the sugar growing industry of Cuba any more than the tin industry of the United States is to be overthrown for the tin industry of Wales, or the pottery industry of the United States for that of Germany, or the silk industry for that of France.

"The census bureau, the agricultural bureau, alike report beet sugar growing a commercial success under the Dingley law. At the rate of progress of the last four years—from 33,000 to 150,000 tons—a decade will see it supplying all of the commodity which the domestic cane fields do not produce. The public man who seeks to disestablish such an interest will simply butt his brains out against an adamantine wall of national usage and predilection. He will combat American institutions in seeking in cold blood to sacrifice a domestic to a foreign industry, and as well might he try to crush Plymouth rock in his teeth or tear down the liberty bell tower with his hands."

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## *ADDRESS BY PROF. H. W. WILEY.*

At a meeting of the Florida State Agricultural Society, Prof. Wiley, chemist of the Department of Agriculture, made an address. He spoke for an hour on the topic of Florida as a sugar-producing state, and said, in substance:

The problems connected with the sugar and starch products are four or five in number. First of all, the soil. Agricultural interest should pay some attention to staple crops, that is, crops that have a market the year round, and can be preserved and marketed at any time.

Sugar and starch are types of such crops. These substances take absolutely nothing from the soil. They are fabricated by the plant from the atmosphere and water, hence the sale of such products does not tend to impoverish the soil.

The soils of Florida are largely of a sandy nature, that is, they have been deposited from water; they are typically different from the soils of the great northwest, which were produced by the grinding effect of moving icebergs, and represent the richest soils probably in the world. Sandy soils are not suitable for producing wheat, for instance, but they are well adapted to producing sugar and starch. In Florida it is more a question of climate, scientific agriculture will produce a crop from almost any kind of soil.

The second problem to be considered is that of fertilizers. Perhaps there is no state more favorably situated than Florida in respect to fertilizers. You have here inexhaustible deposits of phosphate; in the leguminous crops which grow here, namely, peas, alfalfa, and beggarweed. In grass, you have a most valuable means of assimilating nitrogen from the air. In cotton seed, fish scrap and other animal refuse you have access to large stores of nitrogen. Through your seaports stores of fertilizing materials, such at nitrate of soda and potash salts, can be brought from South America and Germany. It would be hard to find any other portion of our country where fertilizers could be more cheaply sold than in this state.

The third problem is the character of the market. This country is the greatest sugar and starch consumer in the world. We use more than 2,000,000 tons of sugar annually. Of this quantity, before the Spanish war, we only made about 300,000 tons, about one-seventh of all.

Since the Spanish war we have acquired Hawaii, Porto Rico and the Philippines, all of which give us large additional quantities of sugar. This year we will produce about 100,000 tons of beet sugar, so that at the present time it may be said that we produce about one-third of all the sugar we consume, but still there is a vast foreign market, which we might supply with the home product. There is no danger, therefore, of overstocking our home market with increased sugar production, nor is there danger of the beet sugar driving the cane sugar out of the market. For many purposes, as for instance the manufacture of syrup, beet sugar is unsuitable, and there will always be a demand for all the cane sugar that can be made.

The sugar crop of the present year of the whole world is about 10,000,000 tons, of which nearly 7,000,000 are made from the sugar beet.

The sugar beet, can, however, not be grown in Florida profitably. Here you must depend on cane for sugar and upon cassava and potato for starch. From starch glucose can also be made, and it seems to me that in the near future the glucose industry will pass from the Indian corn belt to the cassava and potato belt. In one particular industry Florida and the southern parts of Georgia and Alabama stand preeminent, and that is the manufacture of table syrup from sugar cane. It is important, however to secure uniform grades to hold the markets of the world and this can only be accomplished by mixing together the products of small farmers or by the establishment of central factories, where the cane grown in the neighborhood can be manufactued under standard conditions.

By the development of these great industries table syrups, untold wealth in the near future will flow into Florida. As by-products of the factories, immense quantities of cattle food can be obtained, both from sugar cane and the starch-producing plants.

Thus a dairy industry can be established in connection with sugar and starch-making which will add much to the wealth of the state.—Flor. Ag.

## *BUD-VARIATION IN THE SUGAR CANE.*

The latest issue of the West Indian Bulletin, the journal of the Imperial Agricultural Department, contains among its many instructive features a highly interesting article on bud-variation in the sugar cane. The article presents to the public the results of the latest investigations in this comparatively neglected field of research and indicates the promise that future experiments in bud-variation hold out for the improvement of the sugar cane. Some of our leading authorities, it is important to note, are not yet quite satisfied that the well-understood phenomenon known as bud-variation exists in connection with the sugar cane. Thus, Professor Harrison is, or at least was in the earlier 'nineties, among those who professed a strong scepticism with regard to the phenomenon. In the elaborate report on the agricultural work in the Botanic Gardens, British Guiana, 1893-95, for which, in conjunction with Mr. Jenman, Mr. Harrison is responsible, the following passage occurs:

"We do not conisder that a cutting from an older or otherwise favored richer shoot is likely to produce a new plant of superior saccharine strength, and as a matter of fact all our experience disproves this oft-recommended idea, and we know of no analogy supporting it apart from seminal generation, no instance of 'bud variation' having ever occurred in our long daily acquaintance in field and laboratory with the cane."

Equally emphatic is the assertion of Mr. Harrison contained in his work on the agricultural improvement of the sugar cane, published in 1897. Neither Mr. Jenman nor himself, he writes, notwithstanding their extensive experiences with the scientific observation of the sugar cane, "has ever seen anything resembling a 'bud variation' in the case of the sugar cane;" and he adds, "I think that we are justified in assuming that if such variation ever occurs it is only in exceedingly rare cases." Nevertheless Dr. Morris (who, we presume, accepts the views contained in the article under notice) holds the phenomenon to be definitely established. No cases of bud-variation, says the writer, had been recorded, apparently, from the West Indies previous to 1897. "The phenomenon had, however, been observed and taken practical advantage of in other countries"; and numerous quotations are reproduced in support of this statement. For instance, the Director of Forests and Botanic Gardens, of Mauritius, writing in 1900 to Sir W. Thiselton-Dyer, Director of Kew Gardens, expresses the opinion that more and better results will be obtained by good cultivation and by new varieties of canes from "bud-sports" than from raising canes from seed, which he describes as "a long and tedious affair." In Mauritius at present there are in cultivation eight or nine new varieties obtained by bud variation, some of which are "very fine canes," "extensively planted," and most of which "are hardier than their parents and yield more sugar." Dr. Stubbs, of Louisiana, writing in 1897, also quotes illustrations of bud-variation that have come under his notice, but remarks that the new varieties thus secured "have as yet no pronounced excellencies" over the ordinary canes in cultivation. Evidence of the existence of bud-variation in the Antipodes was also supplied recently by Mr. James Clarke, of North Queensland, in a letter to Professor Harrison. It seems, however, that in the West Indies the phenomenon has not only recently been observed but is of comparatively rare occurrence. The cases that are quoted in the article suggest that bud-variation is most evident when the new canes are introduced. "The sudden change of climate, soil, and other circumstances," says the Mauritius Director of the Botanic Gardens, "causes bud varieties to be thrown off." If this is the generally accepted view, it will be understood that the conditions of cane cultivation in British Guiana have hitherto not been favorable to such manifestations. In Barbados, where there are more varieties in cultivation, the conditions are better suited for the development of "bud-sports," and since 1899 several well-defined instances of the phenomenal have come to light. In March, 1900, for example, Mr. S. B. Kirton, proprietor of Arthur Seat plantation, found several stools of cane giving undoubted evidence of bud-variation. One of the stools was submitted to Mr. J. R. Bovell, the well-known Botanical superintendent, who after careful examination felt satisfied that it was a decided case of "sport" or bud-variation. The piece of cane originally planted was of the ribbon variety; from a bud grew a white cane (bearing a remarkably close resemblance to the "Burke" seedling), and this in turn from a bud underground produced a ribbon cane. All these scattered observations lead the writer of the article to a series of conclusions which seem to be well founded. It is probable, he adds, that bud-variation is not so rare as at first appears. The Barbados discovery "was the result of merely one afternoon's observation and of the canes along the hedgerows of one field only;" and the following inadequate and somewhat unsatisfying explanation is offered regarding Professor Harrison's experience:

"No one observer, however diligent, can closely examine a large area of canes. The labor of getting about in amongst the mature canes is too great in the tropics, and he will be limited to those cases which happen to occur along the edges of a field. That this is indeed the case is shown by the instance of Messrs. Harrison and Jenman, who during all their long experience with, and careful observation of, the sugar-cane, had not, at any rate up to 1897, ever seen a case of bud-variation in the field."

Assuming, however, that bud-variation is an accepted factor in connection with the sugar cane, it remains to consider the probable economic value of the discovery. The Mauritius authority, already quoted, describes the new "sports" as for the most part superior to the parent canes; and Mr. Clarke, of Queensland, in his communication on the subject to Professor Harrison, observes that on analysis some of the "sports" gave double the percentage of crystallizable sugar obtained from the mother plant. Dr. Stubbs contents himself with a some what negative testimony as to the value of "sports," whose sugar contents, he says, "are fully equal to those of our home ribbon and purple canes." Speaking in Barbados on the subject a few years ago, Dr. Morris remarked that there was "a distinct value in these sports, as they afforded a means of obtaining a cane of greater merit than at present." Scientists are merely on the threshold of research in this direction and no definite proposition can be built off the investigations already made further than this, that bud-variation in the sugar cane is a well attested phenomenon deserving of the closer study of the scientific experts. The "sports" discovered in Barbados have been planted out in the same fields as other canes undergoing test. "In each case," we are told "the plants from the striped and unstriped canes are growing side by side." In May next year they will be cut, crushed, and subjected to analysis. The official report on the results of the experiment will be waited for with interest, not alone in the West Indian colonies, but in every country where cane sugar is produced. We should add that the value of the article in the Bulletin is enhanced by two colored plates which illustrate the phenomenon of bud-variation.—Demerara Chronicle.

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## *RECIPROCITY OR ANNEXATION.*

The advocates of the incorporation of Cuba into the United States imagine, undoubtedly. that back of the cause which they urge so strenuously is "manifest destiny." Why, indeed, says the Boston Globe (democratic), should the Cuban people trouble themselves at an early date over the mere form of going through the motions of an election? To what purpose can real excitement be raised over the electoral contest in Cuba between Tomaso Estrada Palma on the one side and Bartholomeo Maso on the other as rival candidates, if Cuba is destined surely and steadily to gravitate into place as one of the states of "our indissoluble union"? Such a struggle at the polls could scarcely be looked upon even as a matter of form.

The "logic of events" is at once the most pressing and the most unanswerable that argument can advance. It is, indeed, not always the most agreeable kind of logic to assert in the face of the world, but, as the old adage expresses it, "Necessity knows no law." Cuban sugar and tobacco planters who profess themselves wholly unable to carry on their respective lines of business with even the semblance of success, under existing conditions, may yet be driven into support of the policy of annexation to the United States, if only from motives of self interest.

No further doubt seems to be possible as to the attitude of Gen. Leonard Wood, governor general of Cuba. The weight of influence exerted by this popular administrator has been cast, fully and definitely, on the side of annexation, and it would be sheer folly to attempt to depreciate Gen. Wood's influence upon public sentiment in "the Pearl of the Antilles."

Unquestionably, the President appreciates, to some extent, the fact that there will be strong and strenuous opposition in the republican ranks to any plan, devised on whatever pretext, to reduce the duties on Cuba's sugar and Cuba's tobacco. Our strenuous chief magistrate has but yet only a faint idea of the storm of opposition which the sugar magnates of this country, united with the tobacco growers and tobacco merchants of the Connecticut valley and other sections, can rouse up along the high protective line.

Already "the storm signals are up." The tariff beneficiaries of the country never will give up their contest for continued favor without a serious, stubborn struggle. To these men and their like it is "business" to defend their position and the theory on which it is founded, and "business talks." Far greater in importance to them is it that high protective duties on Cuba's sugar and tobacco should be obstinately maintained than that the growers of these products should be able to earn a livelihood thereby, or that the people of free America should profit by the zeal and enterprise of "thim Cubians."

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Negotiations, now formally concluded, for the placing of a $20,000,000 loan of the German Government in New York, again direct attention to the extraordinary change in this country's position in the world's finance. The floating of these obligations, which appear to be similar in character and maturity to the recent Exchequer bond issue of Great Britain, follows similar accommodation extended to or applied for by Russia, Sweden, and England, and creates a wholly new factor in our investment markets.—Ex.

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Timber 1,000 Years Old.—Experts seem to be divided as to which of the two hard woods—Jarrah and Karri—of Western Australia is the most durable. Jarrah wood piles 2 feet 2 inches square, driven thirty-three years ago at the Largs Bay pier, were found on examination to be as sound as the day they were put in. A specimen of Jarrah wood under similar circumstances showed serious decay. Timber of the Tamarisk or Shittem wood has been found perfectly sound in the ancient temples of Egypt in connection with the stonework which is known to be at least 4,000 years old.—Journal of Horticulture.

## *LIST OF VERNACULAR AND PROPER NAMES OF PLANTS.*

Continued from the last November's number.

BOGOI.—The Fijian name of a handsome EUGENIA growing on sandy sea coast near Levuca, Fiji, from where seeds have been collected. It is a large leaved, handsome, dark green tree of about 20 to 30 feet in height, with large bunches of fruit the size of a fig, becoming scarlet red when growing along the branches. This, however, is not eaten by the natives, as I have been informed. The tree is an addition to beautify our barren coast shores.

BOWENIA Spectabilis.—An ornamental plant belonging to the CICADACEAE, with pretty fern like leaves. From the Queensland Acclimatization Society Gardens, January, 1900.

BRACHYCHITON Acerifolia.—The Australian Flame tree. An evergreen shade tree, attaining a height of sixty feet or more, with magnificent trusses of crimson flowers. Eligible for shading promenades when rapidity of growth is no object. Seeds from N. S. W., Australia, 1899.

BREXIA Spinosa.—Small bushy tree, spiny, ornamental. Native of Madagascar. Seeds from New South Wales, 1899.

BROWNEA coccinea.—A handsome small ornamental tree, with large, scarlet, red flowers.

BROWNEA grandiceps.—A tree as above, with flowers of a pink color, eight inches in diameter. Both of these trees should be extensively grown in parks and gardens. Seeds at Peradeniya Gardens, 1894 and 1900.

BROWNFELSIA Sp.—Seeds of two species of these ornamental shrubs, Sydney, New South Wales, 1899.

BRUGUEIRA gymnorrhiza.—One of the Mangrove trees in the East Indies, where the bark is used as an astringent, for tanning purposes, and for dyeing black. Seers, apparently immature, from Northern New South Wales, December, 1899.

BUTEA frontosa.—The "Dhak" or "Pulas" as India. This magnificent tree extends to the Himalayan Mountains, ascending to elevations of 4,000 feet. It is very rich in a peculiar kind of kino, which according to Muspratt, contains up to 75 per cent of tannin. From the flowers a beautiful red dye is prepared; and the shellac from it is inferior only to that of Schleichera Trijuga (F. F. M.). This appears to be the tree present in Honolulu; one in Mr. Atherton's yard, and the second at the Hon. Mr. Damon's place.

CALLADIUM esculentum.—Ten varieties of "Dry Land Taro" were obtained from the Botanical Gardens at Suva, Fiji, where they were growing in rather damp ground, ditches running through the same, and the surface of ground reach ing about two feet above water level. They have been planted at the Government Nursery.

CALLISTEMON saligne.—One of this Australian "Paper

Bark Tree" is growing at the Government Nursery, introduced many years since by the late Mr. A. Jaeger, and only now beginning to produce seeds. In its native home, along river banks and in swampy places, this tree grows to about sixty feet in height, producing a hard, close grained wood, suitable for wheelwrights' work and implements, proving very durable underground.

CALOPHYLLUM inohyllum.—Although this valuable tree is present in the island, nevertheless large numbers of seeds were picked up along the seashore in Fiji and sent here. It is practically a coast tree, growing so close to the water that the roots are washed by the incoming tide, and here attaining a height of from 80 to 100 feet, yet it will produce a handsome tree most anywhere.

The timber of this giant tree is very important; it is of a medium weight, large hardness, of a brownish red color, and will take a good polish. In India this timber is highly esteemed. It is used to make masts, rafters, planks, in shipbuilding, and especially for articles where a strong and lasting timber is required. In consequence of its importance, this tree is largely cultivated in India, not only for its wood, but also for the gum resin exuding from its bark, the Tacamahac-Gum of commerce. The tree is one of the handsomest found here, and should be planted everywhere to improve the scenic aspect.

CALOPHYLLUM calaba.—A second species of this valuable tree is growing at the Nursery, no doubt brought here from the West Indies, where it is indigenous. The seeds resemble the foregoing, and also yield an oil suitable for many purposes: In Brazil the timber is known under the name of Santa Maria Wood; it has also been employed in shipbuilding in Europe.

CANANGA odorata.—"Ilang Ilang," the name of a perfume derived from the flowers of this large tree, belonging to the ANONACEAE; a native of Sumatra. Many seeds from trees; about one hundred feet in height; Ceylon, 1894.

CHAMAEDOREA.—Pretty little ornamental pot palms, growing in mountain forests in South America, as underbrush. Lorge numbers of seeds obtained in Mexico at various times, up to 1899, of the following species:

CHAMAEDOREA ERNESTI AUGUSTA, from Guatemala.

CHAMAEDOREA GRACILIS, and

CHAMAEDOREA graminifolia, from Mexico and Guatemala.

CARYOPHYLLUS Sp.—A handsome, small dark green leaved tree, with bright red long cylindrical flowers like that of the clove tree to which it is related. Seeds at Suva, Fiji, from plants growing among Mangrove in salt marshes.

CARYOTA Rumphiana.—These handsome palms are found chiefly upon Islands, yet also on the mainland of Asia, where their favorite locality is amongst dense forests along rivers. The above is the handsomest of the genus. Seeds from Acclimatization Gardens, Queensland, January, 1900.

CARYOTA urens.—This is the palm seen so numerous in Honolulu, yet they are poor specimens compared to those seen at Ceylon, from where seeds were sent.

CASTILLOA elastica.—While in Mexico, September, 1898, a quantity of seeds of this Rubber Tree were obtained, yet no trees were raised from the same. One tree furnished, among a collection at Orizaba, proved to be some species of FICUS, instead of the Mexican Rubber Tree which was met with at the Botanical Gardens at Suva, having been received there from the Kew Gardens; a few cuttings of these trees did not reach Honolulu in good condition, and we are as yet without any of the most valuable rubber plants that would succeed in almost any locality with us. In a recent article I have seen *Castilloa alba* mentioned as the best of Mexican castilloas, and the above tree growing well at the Government Nursery, may prove to be this species.

CASTINOSPHERUM Australe.—The Moreton Bay Chestnut. A handsome tree for scenic planting, with large pinnated leaves and pea like resemes of flowers of a bright yellow color, six or eight inches long, and tapering to both ends; it generally contains four seeds, which are rather larger than chestnuts, yet of an inferior quality. Seeds from Queensland, January, 1900.

CEDAR AUSTRALIAN, Cedrela Australis.—Eastern Australian Red Cedar or Cedral. Attains a hight of 200 feet, and sometimes a stem girt of 18 feet near the base. The light beautiful wood is easily worked and susceptible of high polish. It is very much in request for furniture, for turning, for the manufacture of pianofortes, for boatbuilding; it is highly prized for building racing boats which weigh little over thirty pounds, though thirty feet long. Seeds from N. S. W. 1900.

CEIBA pentandra.—The "Kabok," an enormous tree found all through the tropics. It is largely raised for its beautiful silky substance, called "Silk Cotton," which is highly esteemed in tropical countries for upholstering, being extremely light and soft. The price of the same last year in Europe ranged from 12 to 15 cents per pound. Seeds from Fiji.

CELTIS occidentalis, Linne.—The Hackberry tree of Eastern North America; reaching to eighty feet in height; will grow tolerably in the poorest soil. The sweet fruit edible. Wood is rather soft. Trees used largely in cities of Texas, as for shade in streets and parks. Seeds from Texas, 1898.

CELTIS sinensis, Persoon.—China and Japan. With better timber, useful for carpenter and turner's work. Fruit edible, but small. Seeds from Japan and China, 1895 and 1896. Both of these trees growing well in Honolulu.

CIRUELA. Spondias lutea, S. purpurea.—A large seeded fruit the size of a small walnut, which the large tree somewhat resembles; it is cultivated in Mexico, where it is found at all the markets; its rather thin pulp is of an agreeable flavor, and is highly esteemed by the natives. Seeds from the City of Meico during 1897.

CHERIMOYA Anona cherimolia.—We have seen numerous sickly trees and fruits of very small size in Honolulu, compared with what has been seen in Mexico of this, the best of all known fruits, rightly called the American Mangostan. It is a native of Peru and Ecuador, and although strictly tropical, it will not thrive well in low lands, producing but inferior fruits of little value. At the equator, an altitude of about 3,500 to 4,000 feet is most favorable to grow and produce fruits to perfection; in the northern and southern direction this line naturally ends by a height of from 800 to 1,000 feet above sea level. According to Semler, "if the tree is planted at or near the sea coast, it will bear most sparingly, and its fruits are of little value." The fruit, which varies in size from an orange to a cocoanut, in Mexico, is often buried in heaps of mais to obtain the proper maturity and flavor; it should always be eaten with care, partaking of large quantities, and especially the drinking of milk after, has often very ill effects. Since writing the above we have met with this tree in very large numbers growing wild in North Kona and Puuwaawaa. It is said to produce excellent fruit.

CHRYSOBALANUS icaco—West Indies. A tree of importance. It produces a fruit largely made into preserves, which forms an article of trade. Seeds from Suva, Fiji, Nov. 1899.

CIDRA, Citrus cedra.—Likely a variety of this fruit was met with in the State of Merelos, Mexico. A small slender tree with a trunk barely 1½ inches in diameter, supported on sticks; har numerous elongated fruit from 6 to 8 inches in length, consisting chiefly of a thisk rind and hardly any pulp; it is used for making a superior preserve, eaten raw, and for various other purposes. Ten cents for one has been asked in the markets of Mexico. Seeds from that country during 1897.

CITRUS lumina—The sweet lemon. Seeds from markets of City of Mexico, 1897.

CLANTUA pyrifolia—Seeds from N. S. W., Australia, Jan. 1900.

CLIMBERS Cocos Nucifera.—

CLIMBERS, —Under this head come a large number of plants, ornamental and otherwise, of wood climbing and semi-climbing plants, collected at various places visited the last few years.

COCOANUTS, Cocos Nucifera.—Ten varieties of fruit of this valuable plant were obtained at Levuca, Fiji, and may prove at ieast a valuable addition to those already planted.

COBAEA scandens—A well known ornamental climber. Seeds from Orizaba, Mexico.

COCOS flexuosa.—Brazil; extending far north. This sleder and rather tall decorative palm, belongs to the dry Cactus region. It becomes a ctately plant in a few years and produces seeds most freely. From Queensland Acclimatization Society, 190O.

COCOS plumosa.—South Brazil. Has already borne seeds at Jaeger's garden, some three or four years since. This splendid Feather Palm attains a height of 60 feet. It is one of the hardiest of all Palms. Quick of growth, and particularly handsome in tatue. Seeds of all Palms larly handsome in statue. Seeds from N. S. W., and Queensland.

COFFEA Arabica.—Seeds of same from the State of Oaxaca, Mexico, 1897.

COFFEA bengalensis.—The rather small seed of this coffee tree is to my knowledge not used, the plant, however, may prove of value for hybridization. Seeds from Botanical Gardens, Suva, Fiji, and Hong Kong, 1895, 1899 and 1900.

CORYHA umbraculifera.—The Talipot Palm. It is one of the handsomest of the Fan Palms. At its home in Ceylon and the Malabar Coast the straight stem reaches its full height of 60 to 70 feet in from 35 to 40 years. The gigantic leaves have prickly stalks six to seven feet long, and when fully expanded from a nearly complete circle of thirteen feet indiameter. The enormous branching spikes of flowers of this tree can be noticed at a long distance, rising above the leaves twenty to thrity feet in height. After producing large quantities of seeds the plant begins to decay.

Seeds from the Botanical Gardens, Peradeniya, Ceylon, 1900.

CRESCENTIA cajete.—A variety of calabash tree, producing fruit about three times the size seen at Honolulu. As well known, the woody smell of this fruit is made into many useful and ornamental articles. The pulp is esteemed as a medicine; the wood of the calabash tree is light, tough and pliant. Seeds from Botanical Gardens, Suva, Fiji, 1899.

CROTON.—Cutting of some fifty varieties of this ornamental shrubs were obtained chiefly at the Botanical Gardens at Suva, Fiji, many of them will prove new to the already large varieties present.

CRYTOSTEGIA Grandiflora—A handsome flowering, woody climber, from Madagascar. Very rich in milk that will produce an excellent caoutchouc. Seeds from Brisbane, Queensland, 1900.

CRYPTCSTEGIA Sp.—A semi-climbing shrub, growing on dry hills around Cowloong, China. Seeds from same place, March 1900.

MACADAMIA fernifolia—Hhe so called Queensland nut had been previously imported. It is growing admirably in Honolulu, and its nuts are highly esteemed. Seeds from the late Dr. Bancroft, of Brisbane, 1894.

CUPRESSUS Sp. (Lindleyi?)—A large and stately Cypress on the mountains of Mexico. Seeds from Amecameca, 8000 feet altitude, 1897. This tree is growing admirably well on these Islands, and should with other congeners be more largely planted.

CYCAS Australis.—Seeds at Adelaide, S. A., during 1894; given to me as coming from West Australia. This is likely CYCAS media, seeds of which were sent from North Queensland.

CYCAS Circinalis—Seeds at New Caledonia, 1899, from plant originating in New Ireland. Very much resembling Cycas media, with stem somewhat more slender, leaves not so straight and somewhat curly.

CYCAS Rumphii—Indian Archipelago. Seeds from Botanical Gardens of Peradeniya, Ceylon, 1900.

CYPERUS Alternifolius—An elegant greenhouse plant. Seeds from Mexico, 1898.

EUGENIA Malaccensis—The well known Ohia Tree, of the Hawaiian Islands. Seeds of a large variety of fruit at Suva, Fiji, 1899.

EUGENIA Parifolia—A handsome evergreen, small leaved tree, generally found growing along streams. Seeds from N. S. W., Australia, 1899.

SEE BOGOI

EUGENIA Sp.—Another handsome tree with the size and shape of a large aligator pear, of a brilliant red color. From the Botanical Gardens, Suva, Fiji; brought there from New Ireland by the late Gov. Thruston.

EVODIA Hortiensis.—A handsome evergreen shrub; in native villages in Fiji. Yellowish green ppanicles of very fragrant blossoms; a small spray will perfume a whole room for days. Seeds from Fiji, 1899.

MAMMARA Australis—Kauri Pine. North Island of New Zeland. This magnificent tree measures, under favorable circumstances, 180 feet in height, and exceptionally, 17 feet in diameter of stem. It is the tree from which the far famed Kauri timber is derived, and besides is yields the Kauri resin of commerce. These trees grow remarkably well in Honolulu, where apparently two species are growing. They should be planted largely, being, not only one of the handsomest trees present, of apparently quick growth; they all produce an excellent timber. Seeds of this species were sent from Auckland, N. Z., 1899.

The following other species are all of equal value and would do better here than the New Zealand tree.

DAMAMARA Alba.—Agath-Dammar Pine-Indian Archipelago and Mainland.. 100 fee in height; very important on account of its yield of the transparent Dammar resin, extensively used for varnish.

DAMMARA Macrophylla.—Santa Cruz Archippelagos. A beauutiful tree of about 100 feet high.

MAMMARA Moorei—New Caledonia. Said to grow to a height of 50 feet.

DAMMARA Obtusa. —New Hebrides. A fine tree reaching a height of 200 feet, with a long clear trunk.

MAMMARA Ovata—New Caledonia. This tree is rich in Dammar resin.

DAMMARA Robusta. —Queensland-Kauri-A tall tree attaining a height of 180 feet. Also yielding Dammar resin.

DAMMARA Vitiensis—Fiji Islands. A tree about 100 feet in height. I have been informed that this is one of the most valuable timber trees in Fiji, next to the "Vesi" (Afzelia Bijuga), but as it is growing chiefly in the mountains it cannot be reach. We have met with this noble tree on Vitu Levu, from an altitude of 500 to about 2,500 feet, where many large trees were seen destroyed by the natives who collect the Dammar resin by ring-barking the tree, this we have seen used to illuminate the dewllings on festive occasions, producing a brilliant light.

DILLENIA Indica—A handsome lofty tree with very large leaves; fruit about four inches in diameter. We have not seen the flowers of this tree; all the species have them more or less large, often nine inches in diameter and showy, yellow or white; sepals increase in size after flowering, and eventually closely covering the fruit; that of species is eaten in India, and the acid juice sweetened with sugar makes a cooling fever drink. Also produces valuable timber. Many seeds at Hong Kong, 1900.

DION Edule—Mexico. 1,000 seeds from Orizaba 1899. Handsome ornamental plant, belonging to Cycadaceae; its seeds produce a large quantity of starch which is used as arrowroot.

DIOSCOREA—Yams. While at Kamerunga, Cairns, Queensland, during 1894, the late Mr. Cowley kindly gave me the following varieties of these highly nutricious tubers.

D. Fortuna. A large, hard and fibrous species, not porticularly good. (12) specimens.

D. Panna. A small white variety, the best of all yams; much superior to potatoes. (2) specimens.

D. Serpentina. So named by Mr. Cowley fr[illegible] peculiar resemblance to a snake. A New Guinea variety. (2) specimens.

D. Trobriant. Growing upp pto 30 lbs. in weight. (12).

D. Uvi. No doubt D. Alata, the Uvi Yam is meant. India and South Sea Islands. Uuder favorable circumstances will grow to a length of eight feet, and the prodigious weight of 100 lbs. One of the principal kinds grown in the South Sea Islands. (12)

While at Suva, Fiji, Nov. 1899, nine varieties were picked out from a large assortment at the native market and sent here. A red variety is said to be made into poi and eaten with a little salt.

Two species of Dioscorea are indigenous to the Hawaiian Islands, one of these D. Sativa, had largely been cultivated before the introduction of the potato; both the species appear to be an inferior quality, and the introduction of better varieties is likely to again revive the culture.

Showing the comparative value as food; Yams contain 16.3 per cent of starch, 2.2 pper cent of albumen; the sweet potato but ten per cent of starch, and 1.5 pper cent of albumen; (Semler).

Great care is bestowed upon the cultivation of Yams by the natives of Fiji; in new clearings the smaller stumps are left for the vines to climb upon—small bamboo rods are generally used, one to each plpant, three to four feet appart. At a height of about three feet from the ground, these are bent over at a right angle in various directions, forming a frame work for the runners that will shade the ground below. Rich and light soil, as found in the Olaa District, should produce large quantities of Yams per acre, from five to seven months after planting.

DRACANEA Draco—The Dragonblood tree of the Canary Islands; it yields one kind of Dragonblood resin. Many seeds from N. S. W., Australia, 1899.

ERYTHRINA Crista-galli—The cockscomb Coral Tree of Brazil, largely planted as an ornamental tree. Seeds from Brisbane, Queensland, 1900.

ERYTHRINA (Caffra?)—A samll African tree. Seeds from Brisbane, Queensland Jan. 1900.

ERYTHRINA (Indica?)—This tree is largely used as a shade on tea, coffee and cocoa plpantations; it is readily propagated from cuttings simply stuck in the ground where it is wanted. in branches of the thicknee of a thumb to that of an arm, and about awo feet in length. It has long been used in India, Cylon and Java, where the Malays call it "Dadap." It is a quick growing tree with somewhat drooping branches and flowers of an orange red color. Seeds at Kandy, Ceylon, Jan. 1900.

Numerous other species of Erythrina were collected at various times, two in Mexico, at Fiji on the seashore, in Ceylon and China.

ERYTHROXYLON Cocoa—Seeds of the Peruvian plant from the Peradeniya Gardens, Ceylon, Jan. 1900. It is famed for the extraordinary stimulating property of its leaves, which pass under the name of Spadic and Cocoa. They contain two Alkaloids, cocain and hygrin; also a peculia tannic acid. The occain has become of great importance in medicine as topical anaesthetic, particularly in ophplmic surgery. In the native country of the plant, its leaves have for ages been in use for chewing to stave off hunger, thirst, sleep and fatigue; also for allaying local pains. They are also chewed by the Peruvians for the purpose of increasing the endurance of fatigue during long pedestrian journeys. The moderate cosumption of this plant seems to leave no ill effect. (F. V. M.)

Seeds from Peradeniya Gardes, Ceylon, Jan. 1900.

EUCALYPTUS.—We have some fifty varieties of these growing in the forest of Tantalus; some species, will in years to come be of great value, yet the greater part of them will only prove useful as firewood. Seeds of one tree growing on dry limestone formation at Freemantle, W. A., were collected Jan. 1900.

EXOCARPUS Cupressiformis—South Australia. Vernacular name "Native Cherry." Seeds from Adelaide, 1894.

FAGRAEA Berteriana.—A large shrub or small tree of about fifteen feet in height. Flowers showy, very fragrant, white at first, turning yellow with age. Seeds at Suva, Fiji, 1899. We have seen this or a similar plant, growing very luxuriant at Mr. Boyd's residence, Manoa Valley.

FICUS Macrophylla.—The Moreton Bay Fig Tree. Perhaps the grandest of Australian avenue trees, and among the very best to be plpanted, although in poor dry soil its growth is slow. Already in Honolulu, as a large tree in few specimens. Seeds from Sydney, N. S. W., 1899.

FICUS Rubiginosa.—A more compact tree than the foregoing; largely grown in public grounds around Sydney, N. S. W., from where seeds were obtained during 1899.

FICUS Sp.—A large leaved medium size tree. Seeds at Suva, Fiji, 1899.

FICUS Sp.—A very handsome small leaved spreading tree with drooping branches, somewhat resembling our Chinese Ficus Retusa. Seeds at Levuca, Fiji, 1899.

FICUS Sp.—Two other large leaved fig trees growing at Hong Kong. Seeds of same February 1900. It is estimated that the genus Ficus comprises about 600 speciess, many of which come into use as India Rubber producing trees. Ficus Elastica, which is present on the Islands, furnishes a considerable proportion of caoutchouc.

FILICIUM Decipiens.—A very handsome shade tree. Botanical Gardens, Suva, Fiji, 1899.

FLACOURTIA Sepiaria—India. A spiny shrub or small tree with white flowers resembling a semi-double rose. In its natives country, the fruit is sold in the markets, and has a pleasant sub-acid flavor when perfectly ripe. Admirably suited for hedge plant. Seeds at Botanical Gardens,. Suva, Fiji, 1899.

FOREST TREES.—During all the travels over valleys and mountains, while on last visit to Fiji, seeds of various forest trees were collected and sent here.

GLADIOLUS Sp. Var.—Seeds from Orizaba, Mexico, of the best varieties raised for the markets, 1898.

(To be Continued.)

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## *THE LIPTON SYSTEM OF BUSINESS.*

By Sir Thomas Lipton, K. C. V. O.

There is no royal road to riches, and, in a business as big as mine, no back lane. My methods are open, and anybody can see them. A successful concern is created and maintained by the recognition of great facts and obvious principles—the growth of population and the increased facilities of inter-communication among men and nations. These are the great factors in forming great businesses. To supply the many instead of the few, to handle large instead of small quantities, and to be the grower, the manufacturer, as well as the vendor and retailer—to do all this is to adopt, in short, a system of business obvious and open to all.

THE LIPTON RECEIPT FOR PROSPERITY.—If I proceed to speak of my own application of these principles, and of the individual qualities necessary to work them out in the details of business, I fear I must fall back on some very old saws. My receipt for prosperity, in such a concern as mine, is at the disposal of all. Here it is: "Work hard, deal honestly, be enterprising, exercise careful judgment, advertise freely but judiciously."

Though he who drives fat oxen need not himself be fat, a captain of industry must live up to his name—must himself be industrious. That is my belief, and it has been my practice all my life. Beginning work at an early age, I left Glasgow for New York, in the hope of finding shorter avenues to fortune than the old country afforded. I got experience, at any rate—in New York City, on a South Carolina plantation, and elsewhere. I got a little purse together, too; enough to take me back to Glasgow and my parents, to better whose position was then the mainspring of my effort and ambition.

THE GROWTH OF A GIGANTIC BUSINESS.—"Never despair; keep pushing on!" was my motto during all that time of struggle. No successes have been sweeter to me than those early ones which my parents shared with me. In High street, Glasgow, was opened the first of the provision marts which are now numbered by hundreds through England, Ireland, and Scotland. That multiplication of places of distribution was the application, once again, of the great wholesale principles. Expenses of production and of supply decreased as the consumption and the demand increased. I was able to go to my native Ireland as a great buyer of her produce; by degrees I got my own tea plantation in Ceylon; my own carts and ships and ice-storage vans; my own fruit gardens in Kent; my own biscuit factory; my own tin factory. London by degrees became the great center for collection, for storage, and for distribution, and the monster warehouses in the City Road are the result.

It has been said that a certain attention to business is necessary, even for failing in it. Yes; and that gives some clue to the immense attention bestowed by a successful organizer upon his child—his business. To foster it like a child; to know it cannot thrive by itself; to keep an ever-watchful eye on its thousand details; to tie its very shoe-strings, so to speak; and, above all, to do these things one's self and not leave them to the less interested—to do the work that others would do only a little less well—all this is to make the baby of a business thrive and come to a flourishing maturity.

The details of a small business are many; of a great business they are multitudinous. By the number of the details of his work that a man can personally master, one may usually judge of his capacity for success. There are men with a singular grasp for this or that—of a certain limited branch in the great organism of a business, but, outside that special branch, they lack interest and even common intelligence. This may seem to say that the mind capable of large interests and great issues is rare; but I do not intend to say that. The rarity consists rather in the mind of large interests that is able to concentrate itself upon small details and be the master of a hundred branches of a trade, working in all with one object, but having in each, perhaps, a different method of procedure and a separate spirit.

THE STUDIES OF A MASTER TRADER.—Far less facile, for instance, is the mind required in the management of an estate. The manager of a business must have a mind that travels —even as his goods do. Often I have proved to myself the truth of Daniel Defoe's words:

"An estate is a pond, but trade is a spring."

In my case, the spring soon became a brook, the brook a rivulet, the rivulet a river rich and with innumerable tributaries, and navigable for great ships. It is perhaps not too fanciful to say that the master trader's consciousness must follow those tributaries to their own sources. Tea planting in Ceylon, for instance, involves some knowledge of native labor, therefore of native life. Through agriculture the producer touches geology, botany, chemistry, as well as the history of races. It would be unfair to be ignorant of the conditions and circumstances of one's laborers. Under all skies they are sensible of a fellow-feeling. One of the first students of public economy in France in the nineteenth century said that all the difference between a liberal and successful enterprise, and one that was tyrannical and unpromising, lay between the two phrases in the mouth of the master:

"Go to work" and "Come to work."

He said that in farming, at any rate, "Go to work" meant ultimate failure, and "Come to work," with ordinary luck, led securely to fortune.

Even among people accustomed not only to be commanded but driven, the industry of the overseer, who is present, has its sure effect, and the attention of the master who is seen at intervals has its undeniable influence. How much more is this the case in the European workshop and in the complex work of distribution! Here also there is a ready response to the beginnings of profit-sharing. In the agricultural system of one of the best tilled districts of Europe—Central Italy—the cultivator shares the gross profits with he landlord. This is very far from the English system of wages; but I find that a little interest may be pleasantly combined with the routine of the employee. My packers are at work, so many to a table, and I give a bonus to be divided among the workers at the table that shows the greatest number of finished packages. A zealous workman thus not only earns his own gratuity, but helps to earn his comrades', and is in favor with them. This emulation is combined with good-fellowship, and money-making with a little fun.

HARD WORK A LIGHT BURDEN.—How much value I place on industry, and how I believe in devoted hard work at the thing once for all accepted as a man's "calling" in life, may be seen from the fact that even at this stage of my career I generally work from nine in the morning to ten at night. It has been said by many who have a right to speak. that labor is never anything but painful, however willingly undertaken and courageously done. But I think this was the conclusion of men who had one of two kinds of labor to do—the entirely physical and the entirely mental. It is painful to stoop under a burden all day, and "the man with the hoe" is not one of the favorites of fortune.

Nor is the philosopher grappling with infinites anything else than a voluntary martyr. But a mingling of the kinds of work, a variety of interests and of fortunes, the labor of the directing head and that of the obedient hand, the change that traveling brings, even when it is traveling for a purpose—all these make of business anything but a painful vocation.

## REPORT ON FERTILIZATION.

(Continued from last Month.)

Nitrification is believed by many authorities to be accomplished through the agency of three kinds of soil bacteria. One kind changes the nitrogenous material into ammonium compounds, another converts the latter into nitrous acid, and still another completes the work by a conversion from nitrous into nitric acid. These processes are slow and in the course of their operation a gradual distribution of soluble ammonium compounds and nitrates throughout the entire soil very probably takes place. For instance as the ammonia is formed it may be taken up by the water of the soil and carried some little distance before it becomes fixed, and on being oxidized into nitric acid a further dissemination most likely results. The extent of this gradual distribution cannot be measured, but that available nitrogen is carried to parts of the soil remote from the point of contact of the original substance is unquestionable.

POTASH.—This element is usually present as sulphate of potash in Hawaiian fertilizers, although the muriate is also used to some extent. The sulphate on account of its very small effect upon the lime of the soil is favored more than the muriate, and as little difference exists between the prices of the two compounds, the former proves very often the more economical in some localities.

Owing to the rapidity in which potash becomes fixed in loams or soils of a clayey nature, Dr. Stubbs of the Louisiana Experiment Station believes that, in some instances, the more proper time for application would be before planting, in order that the repeated plowing and harrowing might thoroughly distribute the element throughout the soil; otherwise if used as a top dressing it might become entirely fixed in places contingent with the point of application. However, on account of the basic nature of Hawaiian soils, and their smaller content of double silicates as compared with American soils as a rule, potassic fertilizers are much more readily disseminated throughout the soil mass by means of rain or irrigation water. In fact, in the lysimeter tests conducted at the Experiment Station, it was shown that potash was found in the drainage waters where excessive irrigation was followed, and in amounts sufficient to indicate a loss of the potassic fertilizers which had been applied to the soil. Data are lacking to indicate the relative fixing power of potash in the two salts under consideration, but figures may be found in the table on page 14 to show the influence exerted by each form in removing lime from the land. It is seen that nearly nine times as much lime was removed from the land where muriate was added, than resulted from the application of sulphate. The influence of potassium chloride is evidently almost as potent as that of the nitrate of soda in its depleting action on the lime content.

In Mr. Crawley's investigations with the "sandy soils" previously referred to, some very surprising results were reached as regards the disposition of the respective potassic compounds to become fixed under similar conditions in soils of a highly calcareous nature. By referring to the tabulated results on page 17 it will be noticed that none of the chloride or sulphate of potash was lost in the soil containing the least amount of lime carbonate. In the soil with the highest percentage of lime carbonate, 65 per cent of the chloride was lost and 28 per cent of the sulphate. The absorption of potash by these peculiar soils is influenced chiefly by their content of lime carbonate for several reasons. The higher the percentage of lime carbonate the lower must be that of the double silicates in the respective soils, as was pointed out before in considering sulphate of ammonia, and these silicates are particularly instrumental in holding potash. The mechanical condition of the soils is influenced to a large degree by the quantities of lime carbonate that they contain, and as the mechanical condition varies so will the rapidity with which a solution may filter through them. The time that the solutions of potash were in contact with the earth in the pipes influenced in great measure the extent of the resulting chemical changes.

In the early reports of the Experiment Station it was pointed out that in adding chloride of potash to lands bordering on the sea and which are sometimes abnormally high in salt, there is a liability of increasing the proportion of this deleterious substance, and on that account sulphate of potash was advised as the proper form under such conditions.

PHOSPHORIC ACID.—This element exists in fertilizers in many combinations with varying degrees of solubility. It is usually classed as water-soluble, citrate-soluble, or insoluble. In considering the availability of what have been called the essential elements of the soil, it was noticed that although the lands of the Hawaiian Islands are usually very high in phosphoric acid, that very little of it is rendered assimilable during the growth of the crop. On that account it would seem most natural to apply this element in its most soluble form.

The water-soluble phosphoric acid in the form of super or double super-phosphate is readily taken up by rain or irrigation water and distributed more or less throughout the surrounding soil and is rather thoroughly fixed. This fixation is brought about by the carbonate of lime and by the hydrated ferric oxide and alumina present. In the first case, a more or less insoluble phosphate of calcium, and in the second case a basic phosphate of iron or alumina is produced. Although there are Hawaiian soils with no inconsiderable amount of lime carbonate, the great bulk are either lacking in that compound or else contain it only in very small proportions. The predominating bases are those of iron and alumina, and with them the phosphoric acid is rather quickly united; even where calcic phosphate is formed the indications are that the phosphoric acid of this substance is gradually yielded to form combinations with the former. As nearly all the phosphoric acid in the island soils is already a component part of these basic phosphates, it would seem on first consideration that little or no improvement could be effected by a further addition to these insoluble compounds. However, when the soluble phosphoric acid is taken up by the water in the soil it is distributed thoroughly and coming in contact with the minute particles of iron and alumina, results in compounds which on account of their existence in extremely small grains, and on account of their thorough dissemination throughout the soil mass, are in a much more available condition than the natural basic phosphates of the land.

Citrate-soluble, or di-calcic phosphate, although insoluble in water, is soluble in a solution of citrate of ammonia, and is readily absorbed by the acids of the plant roots. Owing to its insolubility in water, however, it cannot be so thoroughly incorporated with the soil, as the form previously described and is of corresponding less value.

By insoluble or tri-calcic phosphate is meant that form which exists in natural or untreated phosphate, and is insoluble in water or citrate of ammonia. In the soil it is rendered slowly available through the processes of decay or decomposition, which action is influenced by the amount of organic matter with which it is associated, the fineness of its mechanical division, and also by the moisture content, depth, and temperature of the soil in which it lies. Dr. Maxwell has pointed out that the acidity of a soil also assists materially in this decomposing action, and attributes the greater effect of bone meal on some of the uplands to the higher moisture and acid content of those soils as compared with the lands of a lower elevation.

LIME.—This element is present in nearly all fertilizers containing phosphoric acid, and as calcium phosphate is added in large quantities to Hawaiian soils. In addition to the lime as phosphate a considerable quantity is also present as sulphate or gypsum in treated phosphates such as the form designated as water-soluble or citrate-soluble, and on account of its fine mechanical and chemical condition is of high value as a fertilizing ingredient.

Ground coral and coral sand are also good as well as cheap sources of this element and are used to a considerable extent on these islands, especially where the content of organic matter is low as well as the lime. The percentages of lime in the various compounds are approximately as follows:

Gypsum ................ 32 per cent of lime.

| | |
|---|---|
| Ground coral ............ | 45 per cent of lime. |
| Coral sand ............... | 49 per cent of lime. |

The difference in lime content between coral sand and ground coral is due to the admixture of shells in the former, which are composed of almost pure lime carbonate. Slaked as well as quick lime are used in some localities, but owing to the readiness with which these forms of lime attack the nitrogenous material of the soil, they are unsuitable for many lands.

FERTILIZERS USED ON THE DIFFERENT ISLANDS.—The amount of fertilizer to be added to any land involves a consideration of the available constituents of the soil, and the demands of cropping. The form in which its ingredients should exist is influenced by a consideration of their respective properties and the existing climatic conditions of the localities in which they are to be applied.

On the Island of Oahu, the average mixed fertilizer contains its phosphoric acid in the water-soluble and citrate soluble forms; the potash is in the form of sulphate; and the nitrogen is applied in three forms, as nitrate of soda, sulphate of ammonia and organic material.

On Maui, fertilizers are applied to a large extent in the same forms as on Oahu, the water-soluble and the insoluble phosphoric acid being somewhat lower. The three forms of nitrogen are generally used in the same fertilizer, although nitrogen as ammonium sulphate is in excess of the organic and nitric. The total nitrogen is 0.6 per cent higher than on Oahu.

On Hawaii on account of the diversity of conditions, fertilizers are naturally found to vary more in their composition than on the other islands. In the Hilo district owing to the heavy rains, nitrate of soda cannot be used without liability to waste, and potash in the form of chloride is in disfavor owing to its depleting action on the lime content of the soils which are already low in that element. Most of the nitrogen used in the district is derived from organic sources and also in some measure from sulphate of ammonia, although some few fertilizers used during the past year contained nitrate. In Hamakua phosphoric acid is applied mostly in soluble forms, the nitrogen as a rule being derived from ammonium sulphate and the potash from sulphate.

On Kauai, nitrate of soda and sulphate of ammonia are favored as sources of nitrogen for mixed fertilizers, very little of this element being applied in an organic form. According to the analyses of the Experiment Station laboratory, Kauai fertilizers are higher in nitrogen as a rule than those from any other island.

On account of the wide variations in the composition of fertilizers and the limited number at hand for forming an estimate, it would be impossible to give average formulas for the different islands which would be reliable for purposes of comparison. The following table will give an idea of the wide differences between the lowest and highest percentages of each element applied in mixed fertilizers of which we have data.

| ISLAND. | Potash. | | Phosphoric Acid. | | Nitrogen. | |
|---|---|---|---|---|---|---|
| | Lowest. | Highest. | Lowest. | Highest. | Lowest. | Highest. |
| | Per Cent. | Per Cent | Per Cent | Per Cent. | Per Cent | Per Cent. |
| Maui.. .. .......... | 4.13 | 17.24 | 5.10 | 14.26 | 5.04 | 9.70 |
| Kauai........... ... | 4.89 | 10.10 | 5.68 | 9.39 | 6.66 | 9.91 |
| Hawaii............. | 4.03 | 22.54 | 5.29 | 14.61 | 3.25 | 10.42 |
| Oahu ............. | 8.50 | 14.66 | 7.01 | 15.00 | 4.70 | 7.10 |

TIME AND METHODS OF APPLYING.—Theoretically the various elements should be added to the land in such proportions and at such times as the crop requires them. This would necessitate repeated applications of small quantities of mixed fertilizers with their respective ingredients in ever varying proportions, due consideration being given to their individual inclinations to waste. It would mean the feeding of the plant according to the needs of its fluctuating growth and development, and the multitudinous changes involved in the elaboration of its products. Agricultural science has not advanced so far as to make such nice calculations possible, and if it had, the cost of labor would not permit the close application of such theoretical doctrines.

Most plantations make two applications of mixed fertilizers during the growth of the crop and the times of these applications vary on different plantations. Some incorporate fertilizing material with the soil of the seed bed before planting and others make the first application when the cane is six to eight weeks old or after suckering has actually commenced. Where two applications are made, the first is usually at the end of the suckering period and the second in the fall or in the following spring, depending on the time of the planting season.

The methods followed in applying fertilizers depends largely upon the kind used. Where the ingredients are in soluble forms, on account of labor considerations the practice on many plantations is to merely drop the material in the furrow beside the cane stalks, without covering. This method should give satisfactory results with any but fertilizers containing organic and insoluble forms such as blood, tankage, etc., which latter substances require a slight depth in the soil to meet the proper conditions for nitrification and satisfactory decomposition.

Dr. W. C. Stubbs, ("Sugar Cane," Vol. 1) says, in speaking of practices in Louisiana: "Nitrates and salts of ammonia are always best used as a top dressing—at short intervals, in small quantities. Dried blood requires but little depth, provided moisture necessary for conversion into available plant food be present. Tankage, bones, and fish scrap must be sunk to deeper depths to obtain fermentation necessary to their conversion into soluble plant food. None of the above should be turned too low, especially in stiff soils, since air, moisture, and heat are the factors needed in decomposition."

It was pointed out in the report of the Experiment Station for 1896, that considerable risk is entailed by applying soluble fertilizers in the furrow under the seed where irrigation is practiced. Under such conditions there is a likelihood of the material being washed down and out of the soil before the young cane is in a condition to appropriate any of it. This would not apply, however, to organic sources of nitrogen or phosphoric acid which are so gradually decomposed, and we understand that such material is giving good results in one locality when applied in such manner.

Mr. Geo. Ross, member of the Committee on Fertilization, writes a very interesting letter on the practices followed on Hakalau Plantation. He says: "At Hakalau I am using almost exclusively a high grade fertilizer of the following average composition. Nitrogen (from sulphate of ammonia and organic ammonia of dissolved bones) 5 to 6%; Phosphoric acid (available) 9 to 10 %; Potash in the form of sulphate of potash, 9 to 10%. This is applied to the plant cane at the rate of 900 lbs per acre in two applications, the first at time of planting and at the rate of 300 lbs. per acre, scattered by hand in the bottom of the furrow, or seed bed, followed by a cultivator to stir it up with the soil. The second application is at the rate of 600 lbs. per acre and just prior to 'hilling up,' or when the cane is too high for further cultivation by mule or horse implements. At this time it is scattered, also by hand, on both sides of the cane row and covered up by small plows which throw the soil in towards the cane, which is afterwards trimmed up by the hoe.

The same grade of fertilizer is applied to all ratoon cane, but usually in one application of about 500 lbs. per acre. It is applied to both sides of the row as is done in the case of the second application to plant cane, and is covered over in the same way by small one horse plows. The usual practice is to apply it to the ratoons as early as possible after the first hoeing.

We have used a fertilizer of this general composition for several years, and although I have experimented to some extent with such special fertilizers as tankage, fish scrap, and bone meal, I have had no results to warrant their continuance. Nitrate of soda on account of its solubility is not adapted to this district, where in the past we have been subject to such heavy rainfall whereby this salt is liable to be lost before being taken up by the plant. Lime always gives satisfactory results and this is true of all soils in this district. Filter-press cake when passed through a disintegrator and applied in liberal quantity gives excellent and lasting results. The same, of course, is true of stable manure. I might state that the percentage of potash in the mixed fertilizer, above referred to was increased from 5 to 6% up to its present strength about three years ago, and with marked results. This was suggested to me from observing the luxuriant growth produced by ashes from timber burnt in forest clearing."

On some plantations a most commendable system is followed of modifying the composition of fertilizers to suit the requirements of the different fields. Mr. D. C. Lindsay, of Paia Plantation says: "Our regular plant cane mixture is composed of super-phosphate, sulphate of potash, nitrate of soda and sulphate of ammonia. We have each field we plant analyzed and vary the proportions of the above ingredients to suit the analysis, so that as a rule every field has a different fertilizer to suit its requirements.

We sometimes use as a special fertilizer a mixture of nitrate of soda and coral lime in equal quantities and apply about 400 to 500 lbs. per acre. We apply this as late as July and August in the same manner as plant cane mixture.

The difference between our plant cane and ratoon mixture, is, that in the latter we increase the proportion of nitrate of soda and decrease the phosphoric ingredient."

Mr. John Watt of the Committee on Fertilization, in writing concerning the practices followed at Honokaa, says that it is customary to apply from 500 to 800 pounds of mixed fertilizer per acre for the crop. "On poor upper lands we give only one. With only one application we distribute the fertilizer in the furrow before the seed is put in, mixing with the soil by a subsoiler or small plow. Where we give two applications the first is given as above and second is given when the cane has about two months' growth, sometimes a little later depending upon the condition of the cane, by distributing the fertilizer along side of the stool and either hoeing it in or running a cultivator along the furrows."

This year the general composition of mixed fertilizer applied at Honokaa has been as follows:

9—10% Phosphoric acid.
8% Ammonia from sulphate.
5% Potash from sulphate.

Mr. Watt says: "The above is the fertilizer which we have used this year and the weather has been so that we cannot tell what results we may have from it. Last year we used a different mixture on the upper lands with very good results, the analysis of which was as follows:

15% Potash from sulphate.
5% Ammonia from sulphate.
10—12% Phosphoric acid.

"With the above fertilizer the cane came up very well and maintained a vigorous growth until it was checked by the very dry weather during the past five months. When we planted this cane we gave it an application of 700 pounds of the above fertilizer with the seed and about four months later we gave it 700 pounds per acre more."

For some years past Mr. Watt has been very careful in regard to the preserving of all stable manure, which is liberally treated with a dressing of superphosphate to prevent loss of ammonia. Both with this compound and with mud-press cakes which have been passed through a disintegrator he has obtained splendid results.

We are in receipt of a very interesting letter from Mr. J. T. Crawley, who writes of a method in vogue at Kihei Plantation for the distribution of nitrate of soda. On account of its bearing so strongly on the question of labor economy the letter is given in full.

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Honolulu, T. H., Sept. 24, 1901.

Chas. F. Eckart,

Chairman, Committee on Fertilization.

Dear Sir:—I wish to include in the report on fertilization a method of applying nitrate of soda devised and used by Manager W. F. Pogue of Kihei Plantation, and communicated to me in a letter from him dated July 26. Mr. Pogue says: "Lacking labor sufficient to apply nitrate of soda with ground coral, I have just finished fertilizing some 600 odd acres with nitrate dissolved in water and applied in the irrigation. The form of application was as follows: Dilute one bag of nitrate of soda in one barrel containing 50 gallons of water, one pail of this solution is added to 4 pails of water, or in that proportion; in another barrel a hose bibb in the bottom of the last barrel discharges the diluted solution into a tub which is kept filled to a given mark, from the tub the mixture flows in an exact amount all day into the main irrigation ditch. The outlet of the tub is fixed, and cannot be opened or closed by the laborer doing the work. Strainers are used on the tub and diluting barrel. In this way one man can easily apply 100 lbs. per acre of nitrate to 60 acres in six days, two men will do three or four times as much. In applying I have put on 75 lbs. of nitrate to an irrigation, then skip one or two irrigations and apply the same amount again.

The fields thus treated have started from short joint sticks to very long joint sticks which means a very rank growth.

It seems to me that any soluble fertilizers can be applied much more evenly and certainly very much cheaper than in the ordinary method.

It also seems to me that if the applications could be made in small doses as the cane needs it, it would be the correct method, exactly as we would feed a horse or a cow."

Again in a letter of Sept. 20, Mr. Pogue says that he is applying 50 pounds nitrate per acre. To quote his words: "We have with my method applied 50 pounds to the acre with one ordinary Jap to as high as 26 acres in one day, that is, 5,250 pounds were applied to 105 acres (one field) in four days by one Jap. The cane began showing the effects on the fifth day, by the seventh day after application, the cane roots had fully gotten hold of the stimulant, from a greenish yellow the leaves were turned a dark green.

We apply 50 lbs. nitrate every other irrigation, or say every 18 days. Cane shows the want of stimulant in from 20 to 30 days, according to nature of soil, after first application, and 30 to 40 days after the second application with this amount of 50 lbs. per acre. Later on, I can give you results of further experiments on these same lines."

The idea of dissolving the nitrate of soda in the water of irrigation was suggested by the scarcity of labor, and Mr. Pogue saw the added advantage of applying this very soluble fertilizer in very small quantities and frequently, rather than in one or two large doses. The only objection that I can see to this method is that there will be loss in the ditches through which the water passes before it reaches the rows of cane, and this loss will depend upon the nature of the soil that compose the bottoms and sides of the ditches. Mr. Pogue states that in the red soils where he is using the method the loss of water is very small. Again, if the part of the row where the water is entering takes up more water than the far end it will likewise take up more nitrate of soda.

The main advantage, aside from the labor question, to my mind is the advantage of applying only so much nitrate as the cane needs at the time, and to be able to apply it in small and frequent doses.

With as fugitive a substance as nitrate of soda this is a great consideration indeed. Whatever of this substance as is not taken up by the cane, can be washed away either by a heavy rain or by a heavy irrigation, and the least amount that is in the soil at any one time the less is the danger of loss.

Very truly yours,

J. T. Crawley.

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This method for the distribution of nitrate of soda, as adopted by Mr. Pogue, apparently has much to commend it, both as regards the saving of labor and the added advantage of being able to apply small quantities of the material as the cane seems to demand it. As the barrel from which the nitrate solution is discharged into the main ditch is kept at a constant level, an even pressure and discharge is obtained which would guarantee a regular and unchanging admixture of nitrate solution and irrigation water. Mr. Crawley's observation as regards probable loss of nitrate during the passage of the water through the irrigation ditches is well taken, though this loss may probably be small and of little consequence as compared with the saving of labor and other advantages to be derived from a following of this method. However this loss is a factor which will be considered later on in a special reference to the use of nitrate on plantations.

A curious point manifests itself in this method of applying nitrate of soda, which would be particularly striking where the cane is planted in long rows receiving their water direct from the main ditch, and less so in proportion as lateral trenches are used and the cane rows shortened. In the former instance the ends of the rows next to the ditch necessarily receive more water than the other extremities and consequently they will receive more nitrate. When this material is distributed in the usual way by hand, each part of the field has approximately the same amount applied to it, and loses it in proportion to the amount of water added providing a point above saturation is reached. At the ditch end of the furrow, according to Mr. Pogue's method a larger quantity of nitrate comes in contact with the cane roots, while in the ordinary method that point is marked by the greatest loss.

Mr. Pogue speaks of the probable advisability of applying all soluble fertilizers in this way on irrigating plantations and the plan certainly presents many favorable points for consideration. However, the question would arise whether the saving of labor and the advantage of small and frequent applications would off-set the loss of soluble high grade fertilizers in the irrigation ditches, which is influenced by the area and nature of the exposed soil. This is a point which must be studied out very carefully before any radical change in the system of applying fertilizers is introduced, and I believe this point may be fully determined by a method which will shortly be presented for consideration.

It has been pointed out that the ends of the furrows next the ditches receive more water than other points along the cane row. Under ordinary conditions the soil at these furrow ends, where long rows are the rule, will soon become saturated and lose a larger quantity of their available plant food than other points, through the leaching action of the excess of water. With that water will go a certain percentage of the fertilizer in solution it is true, but the dissolved elements which leave the irrigation water to become fixed in the soil, would doubtless be more than sufficient to replace the same elements that had been removed from the soil itself. In other words the largest amount of fertilizing material would be added to the points suffering most from ordinary irrigation, on account of the resultant leaching action.

## NITRATE OF SODA.

Owing to the differences of opinion held by plantation managers concerning the efficacy of this substance as a fertilizing compound, I wish to give a consideration of this subject some prominence in this report on fertilization, as I believe that the reasons for this difference of opinion can be largely explained.

In the early reports of the Experiment Station, the readiness with which nitrate of soda is taken up by the cane and its corresponding stimulating action on the plant were referred to at some length. We may quote from the Report of 1895, page 29, where Dr. Maxwell says: "Excepting in locations where the water supply is so small as to retard its quick operation, nitrate of soda is not a safe and normal fertilizer—it is not a good ordinary diet for comparatively slow growing plants. Under the average conditions of moisture and warmth, the plant takes it too greedily, and the result often is abnormal growth. The results of this abnormal growth in cane are bulk, which includes an excess of water and unelaborated products of assimilation, and comparatively less sugar, with low purity of the juice. In wheat and oats the result is lots of straw and little grain. In one case where the manager of a plantation called my attention to a piece of cane, which he called 'very coarse and rank, and would never get real ripe,' I found that 350 pounds of nitrate had been added all at once, and the weather had been such as to allow of the fullest effects. I do not advise nitrate of soda as a regular diet in any situations excepting those of extremely small water supply. I advise nitrate of soda only as a tonic and immediate source of nitrogen in a crisis of a crop, and only in locations of moderate or small rainfall, but never where the rainfall is constant or heavy."

The views of Dr. Maxwell on this subject are clearly set forth, and the advices of the Experiment Station in regard to the use of this material have been largely influenced by his practical observations of field effects following the application of nitrate on plantations.

During the last few months, my attention has been called to the fact that a number of plantations are applying nitrate far in excess of amounts considered safe by the Experiment Station for the normal growth and development of the cane, and reports from these plantations indicate that the cane is doing well. These cases certainly need careful consideration, and a study of the conditions under which nitrate is applied in these instances must necessarily throw considerable light on this important and apparently perplexing problem. Reference has been made to a case where 350 pounds of nitrate, per application per acre, were seen to produce a rank and frothy growth on one plantation where conditions allowed its complete appropriation by the cane. In other instances of more recent observation it is found that 500 pounds, per application per acre, leaves nothing to be desired, the cane presenting not only a vigorous, but a perfectly sound and healthy growth. This apparent inconsistency, I believe may be fully explained, and the explanation will involve a factor of greater economical significance than the nitrate itself, namely that of water supply.

The properties of nitrate of soda have already been discussed, and its ready solubility and disinclination to become fixed in the soil have received special attention. It was noted in the lysimeter tests referred to on page 13 that the loss of nitrate of soda from over-irrigation reached extremely large proportions and those data will now be of particular value in considering the subject in hand. If a plantation were to use say 500 or 600 lbs. of nitrate, per application per acre, also applying more water to the fields than the soil will hold, the excess of water which drains off is necessarily going to carry from the land, a large percentage of the nitrate of soda, and the nitrate remaining in the soil after irrigation is concluded might be easily reduced to such a quantity that a harmful influence could not be exerted on the crop. In other words the cane would not get all of the nitrate applied and a large percentage of this material together with a large amount of water would be going to waste.

It is seen that such a condition of affairs is possible, and with the light of further data it will be seen to be probable. Where a plantation is using large amounts of nitrate without any signs of an injurious action, and where the water of irrigation is practically free from salt, a view that over-irrigation is practiced can only be based on the non-deleterious action of the nitrate of soda; at the present time sufficient data for a thorough confirmation of this opinion are lacking. But if we take a plantation that is using nitrate of soda in large quantities and is irrigating with water of high salt content, sufficient evidence is at hand to show that a large part of that nitrate is being wasted, and in proportion to the amount of water used over and above what is necessary to saturate the soil. This leads us into a consideration of the salt content of irrigation water and of Hawaiian soils, which subject has a particular bearing on the question before us.

In Bulletin No. 90, U. S. Department of Agriculture, entitled "Irrigation in Hawaii," is given a table showing the percentages of salt that have been found in Hawaiian soils, and the resulting condition of cane growing on those lands. The tabulated results are given in full.

## SALT FOUND IN HAWAIIAN SUGAR LANDS, AND ITS EFFECT UPON SUGAR CANE.

| Sample of Soil | Location. | Salt in Soil. Per Cent. | Condition of Cane. |
|---|---|---|---|
| 1.... | Highlands ............. | .061 | Normal. |
| 2.... | " .............. | .063 | Normal. |
| 3.... | " .............. | .050 | Normal. |
| 4 .. | " .............. | .059 | Normal. |
| 5.... | Lowlands...... ....... | .129 | Not wholly healthy. |
| 6.... | " .............. | .130 | Not wholly healthy. |
| 7.... | " .............. | .155 | Quite healthy and normal. |
| 8 ... | " .............. | .181 | Yellow in color. |
| 9.... | " .............. | .181 | Yellow in color. |
| 10 ... | " .............. | .460 | Small, yellow, stunted. |
| 11.... | " ........... ... | .832 | Cane white and dying. |
| 12.... | Sea bluff land.......... | .223 | Leaves bleached, cane small |

Another table gives the effect of salt upon the growth of cane, on "three parts of one field which contained different amounts of salt in the soil, the soil in other respects being identical."

| FIELD. | Salt in Soil. Per Cent. | Yield of sugar per acre. Tons. |
|---|---|---|
| First part.......................................... | 0.10 | 6.0 |
| Second part ........................................ | 0.45 | 1.5 |
| Third part.......................................... | 1.00 | 0.0 |

It is noticed from the first table that where the salt content of the soil reaches over 0.1 per cent an injurious effect is produced on the cane, soil sample No. 7 with 0.155 per cent being an exception.

We will now consider the amount of salt that is found in some of our irrigation waters and take for an example, the water of a plantation which is using 1,000 pounds of nitrate of soda per acre, making two applications of 500 pounds each. The manager of this plantation estimates that he is using about 2,500,000 gallons of water per acre for the crop, and this water is found on analysis to contain over 125 grains of salt per U. S. gallon. If 2,500,000 gallons of water are being applied to the acre, with it go 44,642 pounds of salt, during the growth of one crop. If the land in question were not irrigated to a point above saturation practically none of this water would drain off and the salt would remain in the soil. The weight of an acre of soil to a depth of 12 inches is approximately 3,500,000 pounds, and 44,642 lbs. of salt are practically 1.27 per cent of this amount. This would mean that at the end of five or six irrigations the cane would likely sicken and turn yellow. A certain amount of salt is taken up by the cane itself without apparent bad effects, and the percentage remaining in the soil would consequently be lessened but only to a very small degree and not enough to alter these figures to any appreciable extent.

However the cane on this plantation is doing well and the salty water is having no apparent effect, which would indicate that the salt from the water is not reaching a harmful accumulation in the soil. An undue concentration of salt could only have been prevented by an occassional very heavy rain or by an excessive amount of water used in irrigation. For instance let us say that only so much water was added during five irrigations as the soil would take up and hold. Then this water would evaporate from the surface of the soil and be dissipated into the air through the leaves of the cane, leaving the salt behind, and in quantities sufficient to weaken the growth of the cane. If, however, for the sixth irrigation, double the amount should be used as was applied during any of the previous irrigations, the accumulation of salt would be dissolved up and removed in large measure in the drainage from the land.

The soil would then be freed from its injurious amount of salt and again be suitable for the growth of the cane. This occasional flushing of the land to such an extent is not likely to occur, however, on an irrigating plantation; the chances are in favor of an excess being applied at each watering, and that the amount that drains off from the land during every irrigation is what keeps the salt down below a harmful proportion. The manager of this plantation did not feel that he was using an excess of water, because if he decreased the amount applied, the cane soon showed it. Now on cutting that water down did the cane suffer from too little water or too much salt? To my mind it was more likely the salt which produced the sickening of the cane, because conditions were then made more favorable for an accumulation of that material.

If a soil were irrigated with saline water below a point of saturation, for a number of times, it has been pointed out that the salt solution in the soil necessarily becomes more concentrated and contains a higher percentage of salt than the irrigation water. Providing that the drainage from the land is good and an excess of water can find an outlet through underground or other channels, the more water that is put on in excess of the amount that the soil will hold, the more dilute will become the salt solution in the soil, until a point is reached in which the solution in the soil is practically of the same density as the irrigation water. The more dilute this salt solution is rendered, naturally the more suitable it is for the growth of the cane. But as soils have a high absorptive power for water varying on these islands between 30 and 87 per cent., it is readily seen that after any irrigation where there is much salt in the water, a considerable quantity of that material must necessarily be left behind in the land no matter how much water is applied. When the next application of water is made, the concentrated solution of the soil is added in large measure to the irrigation applied, and the salt percentage of the latter is increased as it passes into the soil, until an amount is added sufficient to leach through the soil and drain off, when the dilution will set in according to the excess of water applied after that point is reached. It can readily be seen what may happen when the irrigation is cut down in some instances and particularly when it is cut down to such a degree as to allow of no drain from the land whatever. If the supply of water were decreased gradually it is not too much to suppose that before a point is reached at which the cane will suffer from too little water, it will suffer from too much salt.

It has been established as a principle in soil physics that if a continuous and rather heavy rain falls evenly upon the surface of a homogeneous soil, a column of water is formed in the soil which will as it descends displace a salty solution without mixing with it to an appreciable extent. If the drainage of the land were good, the salt solution would be forced out of the soil into the natural outlet. In irrigation as practiced on these islands, however, I believe that the diffusive or diluting action of the applied water would be a more potent factor in removing salt from the land, if the soil were deep and of high absorptive power, than that of mere pressure. This is caused by the water having to be distributed throughout the soil from fewer points of application as compared with rain water, and also by the fact that the salt or salt solution in the hills between the furrows where it is carried by capillarity, could not be forced out by any column of water descending from the cane furrow. However, the question of pressure cannot be omitted entirely in a consideration of the manner in which salt is removed from the lands of irrigating plantations, as its importance will increase with the shallowness of the soil and its inability to hold much water.

We have now seen that a plantation which is using very salty water for irrigation purposes must have a well drained soil, and irrigate quite frequently above saturation, in order that the cane may produce a healthy and normal growth, and we now come to the point upon which this question of irrigation bears from a fertilizing standpoint. Under such conditions what becomes of the nitrate of soda that is applied in such large quantities to the land? As nitrate of soda is an extremely soluble material and is but slightly fixed in the soil, large amounts must be leached from the land and lost through the excess of irrigation water used under the existing conditions, and it is not unreasonable to suppose that the amount of nitrate remaining in the soil is decreased to such an extent, that the effects of this material on the crop do not correspond with the effects of the same material added in like quantities, but under conditions where the cane may appropriate the full amount.

These points in regard to the use of salty water on our cane lands open up a new field for investigation along the line of irrigation, but a consideration of that matter must necessarily be left out of a report of this nature.

On a plantation where nitrate of soda is being added to the land in considerable quantities at each application, and where the irrigation water contains in solution only a very small amount of salt, we cannot say positively that over-irrigation is practiced, as at the present time data are lacking to substantiate such a view. The fact that such land is able to stand more nitrate than other lands where irrigation is not practiced, but where the full effects of the nitrate are unquestionably obtained, points to the conclusion that an excess of water may in large measure account for this apparent inconsistency. The original nitrogen content of the soils and the size of the crop are naturally factors to be taken into consideration, but they are not sufficient to account for such variations in the behavior of nitrate as we have found in some instances. Unfortunately over-irrigation is not always manifested in a visible drainage from the land. An excess of water in some instances can sink down into a deep soil below a point from which capillarity can raise it, and find an outlet into an underground reservoir, or along impervious strata into the sea.

The necessity of determining the probable loss of nitrate on a plantation such as we have just described would seem to be of more importance than in the case which has already been considered. Not only is there a likelihood of so much nitrate being lost, but with it is bound up the question of water which, economically, is a matter of greater concern. Where irrigation with brackish water is practiced, more water would necessarily have to be used, than would be the case if the water were "sweet," as an occasional over-irrigation is required. However, in both instances a loss of nitrate and a corresponding loss of water are conditions capable of amelioration, although the degree of conservation of brackish water would vary with its percentage of salt.

On one plantation where nitrate is used in large amounts, the manager informs me that directions are always given to use less water for the first irrigation following an application of nitrate of soda, and this certainly is a good precaution to observe, as in a measure it constitutes a safe guard against the immediate loss of the nitrate. But if we look into this matter more closely, it can be seen that this practice does not insure completely against a considerable loss of this soluble material, although a certain saving would take place, providing of course, that we assume that over-irrigation is the rule, which still remains to be proven. For instance, let us say that 500 pounds of nitrate are applied, and one-half of the water ordinarily used, is applied at the first irrigation following. Then we may feel reasonably certain that none of the nitrate is lost from the land during that irrigation; but the question arises: Can the cane appropriate all of that 500 pounds of nitrate between the time it is applied and the second irrigation following? Such a period we might say would probably cover ten or twelve days at the most, and we may feel sure that all the nitrate could not possibly be assimilated by the cane in that time. What is not assimilated is then liable to waste during the second irrigation and those following.

Although this report is concerned primarily with fertilization, owing to the manner in which soluble fertilizing material may be washed out of the land and lost, the question of over-irrigation must needs be bound up quite closely in an economic consideration of this subject. Through the examination of many soils from various plantations, a wide variation was found to exist as regards their capacities to take up and hold water, and consequently irrigation requirements were seen to vary within very wide limits in different localities. A comparison of the amounts of water used per pound of sugar produced at the Experiment Station and on several plantations, showed a variation between 859 lbs. at the Experiment Station and five and six times this amount on the plantations ("Irrigation in Hawaii," Maxwell). Such results would seem to indicate that a superfluous amount of water had been used and probably still is being used on many plantations. This question from an economic standpoint is certainly one of the highest importance, and although at the present time we have data that point quite significantly to the fact that there must be a waste in many instances, the amount of irrigation water that can be applied to Hawaiian soils, without waste, has never been determined. The importance of the subject would require that a definite conclusion be reached in every case where the conservation of water is a vital consideration, and I believe that this may be accomplished in a practical manner and on the field to which the water is being applied.

In a deep soil where the drainage is evidently through some underground and invisible outlet, any method for the determination of loss of water must be based on the water absorptive power of the soil. If on such a land we can trace the downward movement of the water, and show that a penetration is reached below a point from which capillarity can raise it, the question of loss is fully solved. When water is applied to the land, it is only when the minute capillary pores of the surface are filled, that those immediately below can take up water, and on becoming saturated allow the water to proceed to depths below them. The downward movement of water in a soil is then characterized by an increasing layer of saturated soil which gradually extends toward the lower levels until an outlet is reached and percolation ensues from hydrostatic pressure. Now if we can follow the extension of this saturated layer and note the time in which it comes in contact with a stratum or suitable medium for drainage, we can say positively that any water applied after such time is bound to waste from the land.

By the adaptation of an electrical instrument, termed a soil hygrometer, devised by the Division of Soils, U. S. Department of Agriculture, for determining the moisture content of soils, I believe the point referred to above may be fully determined. In describing this soil hygrometer we will quote from an article of Lyman J. Briggs, Department of Agriculture. "This method depends upon the principle that the resistance offered to the passage of an electric current from one carbon plate to another buried in the soil depends upon the amount of moisture present in the soil between the carbon plates and electrodes. This resistance is measured by a suitable instrument designed for this purpose.

The electrical resistance of the soil between the carbon electrodes depends not only upon the amount of water present in the soil, but also upon the quantity of soluble salts dissolved in the water, and upon the temperature. For soils in which the amount of water soluble material is not sufficiently great to interfere with plant development, field experiments appear to show that for any given water content, the amount of salts in solution remains very approximately the same in any given soil. The determinations made by this method rest consequently upon the assumption that the salt content does not change independently of the moisture content. Wherever we have a translocation of salts due to excessive evaporation or seepage, this assumption will not hold. In such cases the fact that a translocation of salts has taken place is shown by gravimetric moisture determinations which should be occasionally made for this purpose; and if the departure from the previous conditions is not great, the error may be easily corrected.

The effect of the change in the soil resistance due to temperature is eliminated by comparing the soil resistance with the resistance of a small cell containing a solution whose electrical resistance changes with temperature at exactly the same rate as the soil resistance, and which is buried in the soil near the electrode so as to possess always the same temperature as the soil.

The comparison of these resistances is made by an instrument which is a modified form of the well-known Wheatstone bridge method of measuring electrical resistance. The soil resistance and the temperature cell resistance occupy adjacent arms of the bridge, and any change in temperature affects both resistances to the same extent, and so does not change the reading of the instrument."

"The moisture record obtained, consequently deals with the variation in moisture content of the same portion of the soil. This is one of the advantages of the method since it has been shown that the moisture content of a seemingly uniform soil may vary as much as 4 per cent within an area of one square rod. Consequently in order to obtain a consistent record of the change in water content, it is necessary to deal with the same sample of soil, which can only be done by this electrical method."

"We thus see that the electrical method has the advantage of working always with the same portion of soil and furnishes a direct and rapid method of determining the water content after having once been installed."

From the above description an idea may be gained as to the principle of this method for making moisture determinations of the soil in place. In adapting it to meet the requirements of an investigation in respect to the loss of water from the land, these electrodes can be sunk to varying depths in the soil and the movement of water can be traced.

I believe that a number of extremely important facts may be learned from its use on Hawaiian plantations which could not be learned in any other practical way. For instance the amount of water that is lost in irrigation ditches might be determined by noting the depth of soil saturation and the extent of the exposed area. The amount of nitrate of soda that would be held by this amount of water, where that material is applied as at Kihei, could be calculated with fairly reliable results.

Where irrigation with long rows is the rule, the amount of water that is taken up at the ditch end could be measured and compared with the amount absorbed at the other extremity of the furrow.

The amount of salt dissolved in waters may also be determined by this method and an insight gained as to the movements of common salt where brackish water is used in irrigation.

In fact, this method would seem to present a means of solving many problems that have heretofore been the subject of much theoretical speculation, but of which our exact knowledge has been rather limited. In conclusion I will say that the Experiment Station is about to procure one of these soil hygrometers and after a thorough trial in the Experiment Station field I would suggest that investigations be conducted on the cane fields of various plantations where conditions would warrant the expectation that valuable results might be obtained. Respectfully submitted

C. F. ECKART,
Chairman of Committee.

# METEOROLOGICAL SUMMARY FOR 1901.

FROM RECORDS OF THE WEATHER BUREAU, HONOLULU, H. I.

| PHENOMENA. | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | AVERAGES, EXTREMES & TOTALS. | NORMALS AND EXTREMES. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average temperature, Fahr...... | 71.3 | 68.7 | 72.5 | 73.0 | 74.8 | 77.4 | 77.8 | 78 7 | 77.2 | 75.9 | 73.9 | 72.2 | 74.4 Average | 74.0 Normal |
| Average morning minimum....... | 66. | 63. | 68. | 68. | 69. | 72. | 73. | 73. | 71. | 70. | 69. | 67. | 69.0 " | |
| Average mid-day maximum....... | 77. | 75. | 78. | 79. | 82. | 84. | 84. | 85. | 84. | 82. | 79. | 77. | 80.5 " | |
| Mean daily range.. | 11.5 | 12.3 | 9.8 | 11.7 | 13.5 | 11.8 | 11.2 | 11.7 | 13.0 | 11.4 | 9.9 | 10.3 | 11.5 " | 11.0 Normal |
| Greatest daily range | 17. | 20. | 20. | 18. | 19. | 16. | 18. | 21. | 18. | 17. | 16. | 19. | 21. Extreme | 23. Extreme |
| Smallest daily range | 4. | 3. | 4. | 7. | 8. | 8. | 7. | 8. | 8. | 5. | 3. | 3. | 3. " | |
| Highest observed temperature..... | 80. | 78. | 83. | 84. | 84. | 86. | 85. | 88. | 86. | 84 | 82. | 82. | 88. " | 90. Extreme |
| Lowest observed temperature..... | 60. | 54. | 60. | 62. | 64. | 67. | 67. | 67. | 66. | 66. | 63. | 59. | 54. " | 50. " |
| Relative humidity, per cent......... | 73. | 76. | 72. | 79. | 72. | 72. | 68. | 68. | 69. | 76. | 76. | 76. | 74.1 Average | 72.0 Normal |
| Dew point, Fahr... | 62. | 62. | 64. | 68. | 67. | 67. | 66. | 67. | 66. | 68. | 66. | 64. | 65.6 " | 64.0 " |
| Grains of moisture per cubic foot... | 6.14 | 6.07 | 6.52 | 64.5 | 7.38 | 7.35 | 7.07 | 7.31 | 7.12 | 7.45 | 7.08 | 6.32 | 6.92 " | 6.6 " |
| Rain record, days. | 15 | 18 | 25 | 18 | 20 | 18 | 25 | 19 | 17 | 22 | 18 | 14 | 229 Total | 212 " |
| Trade wind, days.. | 20 | 5 | 25 | 22 | 16 | 22 | 30 | 30 | 24 | 26 | 23 | 7 | 280 " | 256 " |
| Daytime cloudiness per cent......... | 36. | 53. | 52. | 54. | 40. | 42. | 44. | 40. | 39. | 47. | 55. | 50. | 46 Average | 43 " |
| Average force of wind, B. Scale.. | 2.4 | 2.2 | 3.0 | 23. | 1.7 | 2.4 | 2.7 | 3.2 | 2.4 | 2.3 | 2.6 | 1.7 | 2.4 " | |
| Rainfall, inches... | 3.10 | 7.96 | 4.12 | 3.11 | 3.23 | 1.42 | 1.53 | 1.03 | 0.85 | 4.14 | 3 34 | 9.98 | 43 81 Total | 38.0 Normal |
| Lowest Barometer. | 29.85 | 29.48 | 29.86 | 29.81 | 29.86 | 29.85 | 29.88 | 29.88 | 29.85 | 29.81 | 29.85 | 29.73 | 29.48 Extreme | 29.40 Extreme |
| Highest Barometer | 30.17 | 30.11 | 30.16 | 30.13 | 30.11 | 30.11 | 30.06 | 30.07 | 30.07 | 30.06 | 30.18 | 30.17 | 30.18 " | 30.26 " |
| Artesian well level. | 34.00 | 34.37 | 34.30 | 34 00 | ...... | 32.85 | 33.40 | . . . | 32.20 | 33.12 | 33.56 | 34.05 | 33.58 Average | 43.0 Orig |

## HONOLULU STOCK AND BOND EXCHANGE, MAR. 17, 1902.

| STOCK | Capital Authorized | Shares Issued | Capital Paid up | Par Value | Last Sale |
|---|---|---|---|---|---|
| MERCANTILE | | | | | |
| C. Brewer & Co. | $ 1,000,000 | 10,000 | $ 1,000,000 | $ 100 | 415 |
| N. S. Sachs' Dry G'ds Co. L'd. | 60,000 | 600 | .......... | 100 | 100 |
| L. B. Kerr & Co, Ltd. | 200,000 | 4,000 | .......... | 50 | |
| SUGAR | | | | | |
| Ewa Plantation Company | 5,000,000 | 250,000 | 5,000,000 | 20 | 23⅜ |
| Hawaiian Agricultural Co. | 1,000,000 | 10,000 | 1,000,000 | 100 | 270 |
| Hawaiian Com'l & Sugar Co. | 10,000,000 | 100,000 | 2,312,750 | 100 | 80 |
| Hawaiian Sugar Company | 2,000,000 | 100,000 | 2,000,000 | 20 | 26½ |
| Honomu Sugar Company | 750,000 | 7,500 | 750,000 | 100 | 130 |
| Honokaa Sugar Company | 2,000,000 | 100,000 | 2,000,000 | 20 | 11 |
| Haiku Sugar Company | 500,000 | 5,000 | 500,000 | 100 | ..... |
| Kahuku Plantation Company | 500,000 | 25,000 | 500,000 | 20 | 24½ |
| Kihei Plant. Co. Ltd | 2,500,000 | 50,000 | 2,500,000 | 50 | 10½ |
| Kipahulu Sugar Company | 160,000 | 1,600 | 160,000 | 100 | .... |
| Koloa Sugar Company | 500,000 | 5,000 | 500,000 | 100 | 164 |
| McBryde Sug. Co. Ltd. | 3,500,000 | 175,000 | 3,500,000 | 20 | 5½ |
| Oahu Sugar Co | 3,600,000 | 36,000 | 3,600,000 | 100 | 90 |
| Onomea Sugar Co | 1,000,000 | 50,000 | 1,000,000 | 20 | 23 |
| Ookala Sugar Plantation Co. | 500,000 | 25,000 | 500,000 | 20 | 8 |
| Olaa Sugar Co. Ltd., Assess. | 2,500,000 | 125,000 | 865,000 | 20 | 5¾ |
| Olaa Sugar Co. Ltd., Paid up | 2,500,000 | 125,000 | 2,500,000 | 20 | 13⅜ |
| Olowalu Company | 150,000 | 1,500 | 150,000 | 100 | ..... |
| Paauhau Sug. Plantation Co. | 5,000,000 | 100,000 | 5,000,000 | 50 | ..... |
| Pacific Sugar Mill | 500,000 | 5,000 | 500,000 | 100 | ..... |
| Paia Plantation Company | 750,000 | 7,500 | 750,000 | 100 | 250 |
| Pepeekeo Sugar Company | 750,000 | 7,500 | 750,000 | 100 | ..... |
| Pioneer Mill Company | 2,250,000 | 22,500 | 2,250,000 | 100 | 100 |
| Waialua Agricultural Co. | 4,500,000 | 45,000 | 4,500,000 | 100 | 52½ |
| Wailuku Sugar Company | 700,000 | 7,000 | 700,000 | 100 | 370 |
| Waimanalo Sugar Company | 250,000 | 250,000 | 250,000 | 100 | 160 |
| Waimea Mill Company | 125,000 | 125,000 | 125,000 | 100 | 87 |
| MISCELLANEOUS | | | | | |
| Wilder Steamship Company | 500,000 | 5,000 | 500,000 | 100 | 100 |
| Inter-Island Steam Nav. Co. | 600,000 | 6,000 | 600,000 | 100 | 100 |
| Hawaiian Electric Company | 500,000 | 5,000 | 500,000 | 100 | 110 |
| Honolulu R. T. & Land Co. | 250,000 | 2,500 | 250,000 | 100 | 90 |
| Mutual Telephone Company | 150,000 | 13,900 | 139,000 | 10 | 8 |
| Oahu Railway & Land Co | 4,000,000 | 40,000 | 4,000,000 | 100 | 90 |
| BANKS | | | | | |
| First National Bank | 500,000 | 5,000 | 500,000 | 100 | ..... |
| First Am. Sav. B. & Trust Co. | 250,000 | 2,500 | 250,000 | 100 | ..... |
| BONDS | Amt. of Issue | | | | |
| Hawaiian Govt. 5 per cent | 1,251,200 | Dec. 31, 1900 | .......... | ..... | 97 |
| Hilo Railroad Co., 6 per cent | 1,000,000 | 750,000 | .......... | ..... | ..... |
| Hono. R. T. & L. Co, 6 p. c. | 300,000 | ........ | .......... | ..... | ..... |
| Ewa Plantation 6 per cent | 500,000 | ........ | .......... | ..... | 100 |
| Oahu Railway & L'd Co 6 p. c. | 2,000,000 | ........ | .......... | ..... | 104 |
| Oahu Plantation 6 per cent | 750,000 | ........ | .......... | ..... | 100 |
| Olaa Plantation 6 per cent | 1,250,000 | ........ | .......... | ..... | ..... |
| Waialua Agr. 6 per cent | 1,000,000 | ........ | .......... | ..... | 101 |

# PLANTATION DIRECTORY.

| Island and Name. | | Manager. | Post Office |
|---|---|---|---|
| **OAHU.** | | | |
| EwaPlantation Co | * | G. F. Renton | Honouliuli |
| Waianae Sugar Co. Ltd | *** | Fred Meyer | Waianai |
| Waialua Agricultural Co | * | W. W. Goodale | Waialua |
| Kahuku Plantation Co | xx | Andrew Adams | Kahuku |
| Waimanalo Sugar Co | ** | G. C. Chalmers | Waimanalo |
| Oahu Plantation Co | x | Aug. Ahrens | Waipahu |
| Honolulu Sugar Co | ** | J. A. Low | Aiea |
| Heeia Agricultural Co. Ltd | *x* | W. W. McGowan | Heeia |
| Laie Plantation | x*x | S. E. Wooley | Laie |
| **MAUI.** | | | |
| Olowalu Sugas Co | ** | E. Kruse | Lahaina |
| Pioneer Mill Co | x | L. Barckausen | Lahaina |
| Wailuku Sugar Co | **x | C. B. Wells | Wailuku |
| Hawaiian Commercial & Sugar Co | x* | H. P. Baldwin | Sprecklesville |
| Paia Plantation | x* | D. C. Lindsay | Paia |
| Haiku Sugar Co | x* | H. A Baldwin | Hamakuapoko |
| Hana Plantation | xx | K. S. Gjerdrum | Hana |
| Hamoa Plantation | **x | J. R. Myers | Hamoa |
| Kipahulu Sugar Co | x | A. Gross | Kipahulu |
| Kihei Plantation | x* | James Scott | Kihei |
| Maui Sugar Co | † | W. S. Akana | Huelo |
| **HAWAII.** | | | |
| Paauhau Plantation | ** | Jas. Gibb | Honokaa |
| Hamakua Mill Co | *x | A. Lidgate | Paauilo |
| Kukaiau Plantation | x | J. M. Horner | Paauilo |
| Kukaiau Mill Co | *x | E. Madden | Paaulio |
| Ookala Sugar Co | **x | W. G. Walker | Ookala |
| Laupahoehoe Sugar Co | *x | C. McLennan | Papaaloa |
| Hakalau Plantation | ** | Geo. Ross | Hakalau |
| Honomu Sugar Co | **x | Wm. Pullar | Honomu |
| Pepeekeo Sugar Co | *x | H. Deacon | Pepeekeo |
| Onomea Sugar Co | **x | J. T. Moir | Papaikou |
| Hilo Sugar Co | ** | J. A. Scott | Hilo |
| Hawaii Mill Co | x | W. von Graevemeyer | Hilo |
| Waiakea Mill Co | *x | C. C. Kennedy | Hilo |
| Hawaiian Agricultural Co | **x | C. M. Walton | Pahala |
| Hutchinson Sugar Plantation Co | ** | G. C. Hewitt | Naalehu |
| Union Mill Co | *x | Jas. Renton | Kohala |
| Kohala Sugar Co | * | E. E. Olding | Kohala |
| Pacific Sugar Mill | x** | D. Forbes | Kukuihaele |
| Honokaa Sugar Co | x** | Jno. Watt | Honokaa |
| Kona Sugar Co | xxx | J. Cowan | Holualoa |
| Olaa Sugar Co | xx* | F. B. McStocker | Olaa |
| Puna Sugar Co | xx* | W. H. Campbell | Kapoho |
| Halawa Plantation | x*x | T. S Kay | Kohala |
| C. F. Hart, (Niulii) | *x | R. Hall | Kohala |
| Hawi Mill & Plantation | †† | John Hind | Kohala |
| **KAUAI.** | | | |
| Kilauea Sugar Co | ** | G R. Ewart | Kilauea |
| Gay & Robinson | x*x | Gay & Robinson | Makaweli |
| Makee Sugar Co | **x | G. H. Fairchild | Kealia |
| Grove Farm Plantation | x | G. N. Wilcox | Lihue |
| Lihue Plantation Co | x | F. Weber | Lihue |
| Koloa Sugar Co | x | P. McLain | Koloa |
| McBryde Sugar Co | *x | W. Stodart | Eleele |
| Hawaiian Sugar Co | x* | W. A. Baldwin | Makaweli |
| Waimea Sugar Mill Co | * | J. Fassoth | Waimea |
| Kekaha Sugar Co | x | H. B. Faye | Kekaha |

| Key | Honolulu Agents | |
|---|---|---|
| * | Castle & Cooke | (4) |
| ** | W. G. Irwin & Co | (8) |
| *** | J. M. Dowsett | (1) |
| x | H. Hackfeld & Co | (9) |
| xx | M. S. Grinbaum & Co | (2) |
| xxx | McChesney & Sons | (1) |
| *x | T. H. Davies & Co | (8) |
| **x | C Brewer & Co | (7) |
| x* | Alexander & Baldwin | (5) |
| x** | F. A. Schæfer & Co. | (2) |
| xx* | B. F. Dillingham & Co | (2) |
| x*x | H. Waterhouse & Co. | (2) |
| *x* | C. Bolte | (1) |
| † | Wong Kwai | (1) |
| †† | Hind, Rolph & Co | (1) |